PEMBANI COAL MINE

PROPOSED UNDERGROUND MINING ON THE FARM ZANDVOOT 10 IT, NEAR CAROLINA, ALBERT LUTHULI LOCAL MUNICIPALITY, GERT SIBANDE DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE.

HERITAGE STUDY: IMPACT ASSESSMENT REPORT

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FOR

ENVIRONMENTAL IMPACT MANAGEMENT SERVICES (PTY) LTD

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DECLARATION OF INDEPENDENCE AND SUMMARY OF EXPERTISE

The report has been compiled by PGS Heritage, an appointed Heritage Specialist for Environmental Impact Management Services (Ltd). The views stipulated in this report are purely objective and no other interests are displayed during the decision making processes discussed in the Heritage Impact Assessment Process.

HERITAGE CONSULTANT: PGS Heritage

CONTACT PERSON: Polke Birkholtz

SIGNATURE: 

Polke D. Birkholtz, the project manager and archaeologist, has a BA Honours (cum laude) in Archaeology from the University of Pretoria (1997) and has been actively involved in the heritage industry since that year. He has been responsible for managing and undertaking in excess of 240 heritage and archaeological impact assessments across South Africa and is well versed in the applicable legislation as it relates to heritage in South Africa. Polke Birkholtz has also managed and conducted a number of Phase 2 mitigation projects, including archival and historical research on various projects across the country, archaeological excavations on Late Iron Age sites in Gauteng, Mpumalanga and the Limpopo as well as archaeological excavations on historic sites in Gauteng, Free State and the Northern Cape. He has also managed and conducted a large number of grave relocation projects in Gauteng, Mpumalanga, North West Province, Limpopo and the Free State. Polke Birkholtz is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a professional archaeologist and is a member of the Cultural Resource Management (CRM) Section of ASAPA.

Dr Gideon Groenewald, who conducted the palaeontological desktop study, has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

EXECUTIVE SUMMARY

PGS Heritage was appointed by Environmental Impact Management Services (Ltd) (EIMS) to undertake a Heritage Impact Assessment for proposed underground mining on the farm Zandvoort 10 IT for the existing Pembani Coal Mine. This farm is located 3.5 km north east of Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

The purpose of the Heritage Impact Assessment report is to assess the impacts of a proposed development on the identified heritage resources. This is important because heritage resources are protected in terms of the National Heritage Resources Act, No 25 of 1999, (NHRA) from *inter alia*, destruction or damage, excavation or removal, or other disturbance, without a permit from the responsible heritage resources authority. The National Heritage Resources Act, No 25 of 1999, (NHRA) states that heritage resources are unique and non-renewable and, as such, any impact on such resources must be seen as significant (NHRA, section 5(1)(a)). The NHRA specifically protects certain categories of heritage resources, i.e.: structures, archaeological and paleontological (including meteorological) sites and material and graves and burial grounds (NHRA, sections 34, 35 and 36). Furthermore, Section 38 of the NHRA provides for and regulates the compilation of impact assessment reports of heritage resources that may be affected by construction or development activities.

The desktop research undertaken for this report has revealed that the study area and surrounding landscape have an archaeological and historical history which spans a very long time. This suggested that the study area has the potential of containing archaeological and historic sites related to this timeline. Archival research conducted during the desktop study also revealed historical information relating to the early farm ownership history of Zandvoort and indicated that the farm had amongst others been owned by historical figures such as Alois Hugo Nellmapius and Hermann Ludwig Eckstein. At this point it must be noted however that although at specific periods of time these two historical figures owned portions of the farm, Zandvoort was never their home but rather formed part of a large number of farms and properties owned at any given time by these individuals as part of their respective business pursuits. An assessment of archival and historic maps was also undertaken to provide a historic layering of the study.

A team comprising two archaeologists conducted fieldwork of the study area. As no surface impacts are envisaged, the fieldwork focussed on assessing those sections of the study area with the highest potential of containing archaeological and heritage sites. This being said, the fieldwork team visited all areas of the study area. A total of seven heritage sites were identified during the fieldwork, four of which form part of a single farmstead, namely a farm dwelling, rondavel, garage and shed. The farm dwelling (and potentially associated shed and rondavel) was built in c. 1911 and as a result is older than 100 years. The three other sites identified on the property include one historic cemetery, one possible informal grave and an old farm dipping structure.

The only identified impacts on heritage resources as a result of the proposed underground mining for coal at Zandvoort 10 IT, would be on palaeontology as well as the potential (though highly unlikely) surface impact on the seven identified heritage sites. Such highly unlikely surface impacts may be surface subsidence or vibration.

Palaeontology

A palaeontological desktop study was commissioned from Dr. Gideon Groenewald and represents the final component of the desktop study. His report indicates that the study area is mainly underlain by Permian aged rocks of the Dwyka Group and Vryheid Formation, Ecca Group, Karoo Supergroup and Jurassic aged dolerite sills. The very high fossiliferous potential of the Vryheid Formation, Ecca Group strata, warranted an allocation of a Very High palaeontological sensitivity in the report to the areas underlain by the rocks of the Vryheid Formation. The Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity. The report also stated that if underground mining is planned, all the areas of mining will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils.

The following mitigation measures are required:

- A palaeontologist must conduct a single one-day site visit to the present mining operation on the property located adjacent to Zandvoort as soon as possible to inspect the presence of possible fossil material in the spoil heaps of the existing mine. This site visit would be aimed at assessing the potential for significant fossils to be impacted upon by the proposed underground mining activities on the Zandvoort property.
- Two possible outcomes may result from the site visit, namely: (a) the palaeontologist finds that there is no potential for significant fossil material to be impacted upon by the proposed underground mining activities. Subsequently, the palaeontologist will provide a write up of his/her findings indicating that no further work would be required. This write-up will be submitted to SAHRA. (b) The palaeontologist establishes that the potential for significant fossil material to be impacted upon by the proposed mining property does exist. The palaeontologist must then provide a write up of his/her findings and submit this to SAHRA. The appointed palaeontologist, in consultation with the mining company, must then develop a long-term strategy and budget for the recovery of significant fossils during the mining operation. This strategy may include site visits to monitor the spoil heaps, the collection of representative samples as well as the curation of fossil material.

In Chapter 8 the impact on palaeontology is identified as an environmental sensitivity, whereas Chapter 9 identifies it as an environmental constraint. The impact of the proposed development on palaeontology in terms of two different alternatives is assessed in Chapter 10 and mitigation measures and an action plan to mitigate the impact on palaeontology is outlined in Chapters 11 and 12 respectively.

Identified Heritage Sites

All seven identified heritage sites are surface occurrences and as a result the proposed underground mining activities at Zandvoort 10 IT are not expected to have any direct negative impact on any of these seven heritage sites. Such surface impacts are unlikely if mining is undertaken correctly and safely because of the safety factors required. However potential impacts include vibration and surface subsidence, although these are highly unlikely to occur.

In the instance that such highly unlikely surface impacts do occur, the identified heritage sites which would potentially be at highest risk would be the white cemetery (with its large upright headstones) (see Site 2) and the farm dwelling (Site 4).

In Chapter 8 the impact on the identified heritage sites is identified as an environmental sensitivity, whereas Chapter 9 identifies it as an environmental constraint. The impact of the proposed development on the identified heritage sites is assessed in Chapter 10 and mitigation measures and an action plan to mitigate the potential (though highly unlikely) impact on such identified heritage sites is outlined in Chapters 11 and 12 respectively.

Conclusions

This heritage impact assessment has identified a total of seven heritage sites located within the study area, whereas the palaeontological desktop study has allocated a Very High palaeontological significance to all underground mining areas. All these identified heritage aspects were identified as environmental sensitivities as well as environmental constraints. The impact of the proposed development on these sensitivities and constraints in terms of two different alternatives were assessed. Suitable mitigation measures as well as an action plan were outlined to suitably mitigate the impact of the proposed development on these heritage sensitivities.

It is the opinion of the author of this report that if the mitigation measures outlined in this report are implemented as indicated, the proposed development can be allowed to proceed.

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ANNEXURES

1. INTRODUCTION

PGS Heritage was appointed by Environmental Impact Management Services (Ltd) (EIMS) to undertake a Heritage Impact Assessment for proposed underground mining on the farm Zandvoort 10 IT for the existing Pembani Coal Mine. This farm is located 3.5 km north east of Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

2. SCOPE OF WORK

2.1 Overview of the Scope of Work

PGS Heritage was appointed by EIMS to undertake a Heritage Impact Assessment (HIA). The aims of the study are to identify heritage sites and finds that occur in the proposed development area as well as to assess the impact of the proposed development on these identified heritage sites. The Heritage Impact Assessment aims to inform the EIA in the development of a comprehensive EMP to assist the developer in managing the identified heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

The scope of work for the Heritage Impact Assessment Phase of the project can be itemised as follows:

- A detailed Heritage Impact Assessment based on the proposed activities. Impacts must be calculated for each phase of the project and these phases shall be classified as:
  - Planning and Design;
  - Construction;
  - Operation;
  - Decommissioning;
  - Rehabilitation and Closure.
- Identification and description of site sensitivities (if none, motivate why not);
- Identification and description of site constraints (if none, motivate why not);
- Identified potential impacts must be evaluated in accordance with the agreed methodology to determine significance. Identified potential impacts (cumulative, direct and indirect) must be quantified (where possible) and fully described for each feasible alternative utilising the EIMS Impact Assessment template provided by EIMS.
- Residual and latent impacts after mitigation must be evaluated (in accordance with the assessment methodology described above) that actual implemented results can be measured against those predicted;

- Each specialist will be required to contribute to the preparation of a detailed site specific EMP relating to the specific field of expertise and impacts identified;
- Provide detailed mitigation / management measures for the management of the identified impacts for inclusion in the EMP. The mitigation / management measures must be presented in a tabulated format for each phase of the project and must include:
    - Detailed description of mitigation measures or management options;
    - Roles and Responsibilities for Implementation;
    - Timeframes for implementation;
    - Means of measuring successful implementation (Targets & Performance Indicators).
- Compilation of an Action Plan for Implementation of the recommended mitigation measures. This plan must, at a minimum, include the following:
    - Management Actions for Implementation;
    - Responsibilities for Implementation, Monitoring and Review;
    - Timeframes for implementation;
    - Means of measuring successful implementation (Targets & Performance Indicators).
- Any other Recommendations;
- Identify any gaps in knowledge, data or information;
    - Report on the adequacy of predictive methods utilised
    - Report on the adequacy of underlying assumptions;
    - Report on uncertainties in the information provided.

2.2 Definition of Study Area for Scope of Work

PGS Heritage was appointed by EIMS to undertake a Heritage Impact Assessment (HIA) for proposed underground coal mining activities. A detailed desktop study was undertaken (which included a paleontological desktop study) followed by fieldwork. During the fieldwork a total of seven heritage sites were identified, four of which form part of a single farmstead, namely a farm dwelling, rondavel, garage and shed. The three other sites include one cemetery, one possible informal grave and an old farm dipping structure.

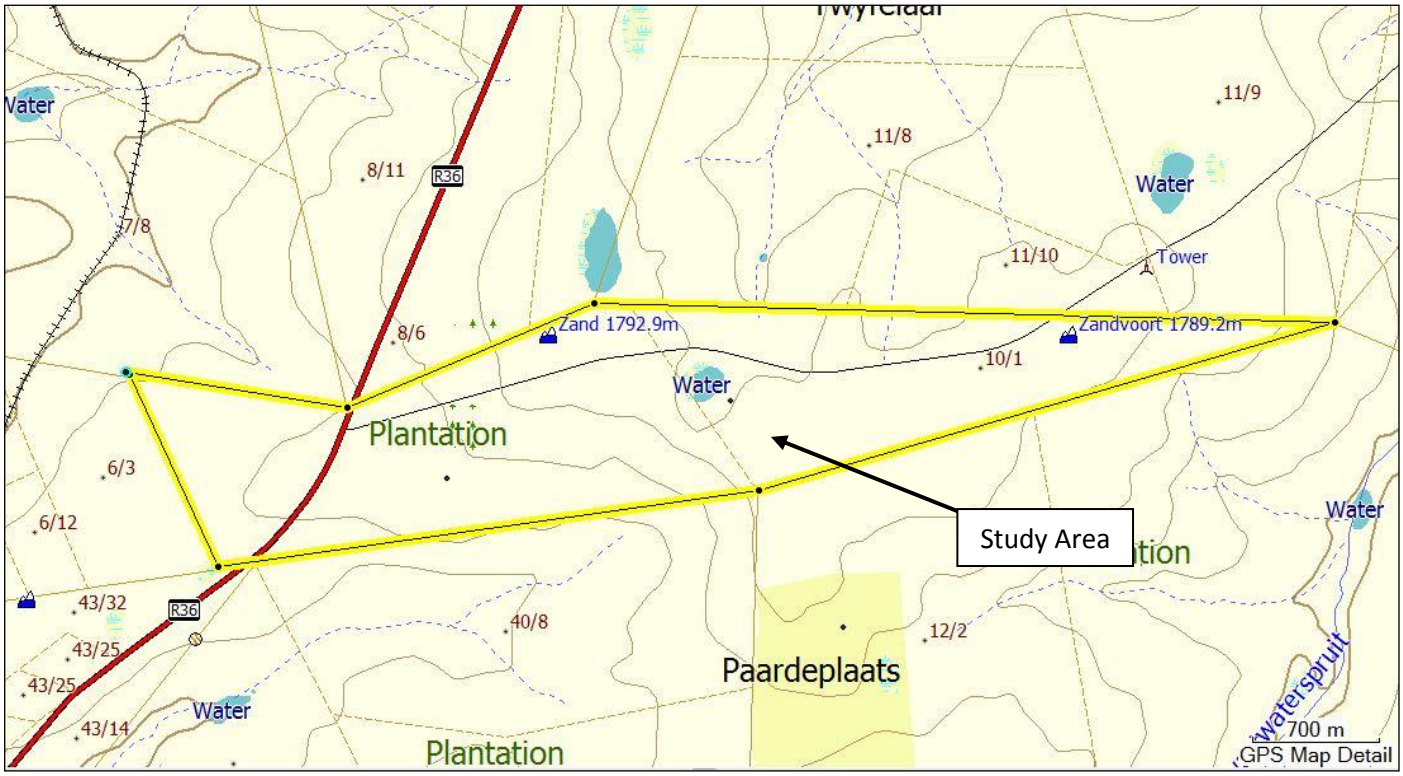

Figure 1 - The study area within its regional context

DEFINITION AND DESCRIPTION OF STUDY AREA		
Coordinates	S26° 01’ 56.2” E30° 08’ 06.9” S26° 02’ 02.3” E30° 08’ 50.6” S26° 01’ 43.6” E30° 09’ 38.8”	S26° 01’ 46.3” E30° 12’ 06.0” S26° 02’ 16.5” E30° 10’ 11.9” S26° 02’ 30.2” E30° 08’ 24.2”
Property	The farm Zandvoort 10 IT, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.	
Location	The study area is located 3.5km north-east of Carolina and is 41.5km south-east of Belfast.	
Extent	The extent of the study area is roughly 473 hectares.	
Land Description	The study area’s northern and central sections are topographically level whereas it slopes down towards the south. The undisturbed sections of the study area can be described as primarily open grassland interposed by pockets of black wattle trees. A circular pan is located near the center of the farm. Agricultural fields are located near the center and on the western ends of the farm with the remainder used for grazing purposes. The original farmstead and associated buildings and features are located in the western half of the property, with farm roads providing access to almost all segments of the farm. A provincial gravel road cuts across the northern end of the farm and a provincial tar road (R36) splits the western end of the farm from the remainder of the property.	

3. METHODOLOGY

3.1 General Methodology

PGS Heritage was appointed by Environmental Impact Management Services (EIMS) to undertake a Heritage Impact Assessment (HIA) which forms part of the mining right amendment process (Section 1023 process) to incorporate Zandvoort 10 IT into the existing mining right of the Pembani Coal Mine. This amendment is for proposed underground mining on the farm Zandvoort 10 IT for the existing Pembani Coal Mine and is located in the Albert Luthuli Local Municipality, Gert Sibande District Municipality of the Mpumalanga Province. The applicable maps, tables and figures are included as stipulated in the NHRA (no 25 of 1999) and the National Environmental Management Act (NEMA) (no 107 of 1998).

The methodology for the Heritage Impact Assessment Study comprised the following:

- To conduct an intensive archaeological and historical desktop study of the study area and surroundings.
- To conduct a pedestrian and vehicular survey of the study area to identify any heritage sites located there.
- To compile the findings of both the desktop study and fieldwork into a single report during which an assessment of the impact of the proposed development on the identified heritage sites can be made and mitigation measures provided.

In practical terms the HIA process consisted of three steps:

Step I – Desktop Studies: Information was sourced from repositories such as the National Archives in Pretoria.

Step II – Fieldwork: Fieldwork was conducted over the course of two days namely Wednesday, 29 April 2015 and Thursday, 30 April 2015. The survey was undertaken by a team comprising two professional archaeologists (Polke Birkholtz and Jessica Angel). As only underground mining is proposed within the study area, the fieldwork comprised both a pedestrian and vehicular survey with emphasis placed on those areas of the study area with the highest potential of containing heritage and archaeological sites. This said, almost all sections of the farm were visited on foot or by vehicle. Ms. Sophie Zikalala, who looks after the cows on the farm, was asked if she was aware of any graves or cemeteries on the farm. She indicated that she has not seen any graves on the farm.

Step III – Report: The final step involved the recording and documentation of relevant heritage resources, as well as the assessment of resources regarding the heritage impact assessment criteria and report writing, including mapping and recommendations.

The methodology used in this study to assess heritage site significance can be found in Annexure A whereas the methodology used to assess the impact significance is outlined in Annexure B.

3.2 Assumptions and Limitations

- This report is a Heritage Impact Assessment report compiled for proposed underground mining activities only. Should any surface impacts be proposed in future, the relevant footprint areas will have to be covered by further fieldwork and the Heritage Impact Assessment report updated.
- This report is based on the premise that all surface impacts associated with the proposed underground mining operations at Zandvoort 10 IT will be located on adjacent properties which had already been assessed by heritage impact assessment reports.

3.3 Terminology/Abbreviations

Table 1- Abbreviations

ACRONYMS	*DESCRIPTION*
AIA	**Archaeological Impact Assessment**
ASAPA	**Association of South African Professional Archaeologists**
CRM	**Cultural Resources Management**
DEA	**Department of Environmental Affairs**
DWA	**Department**: **Water Affairs**
DMR	**Department of Mineral Resources**
ECO	**Environmental Control Officer**
EIA practitioner	**Environmental Impact Assessment Practitioner**
EIA	**Environmental Impact Assessment**
EMPR	**Environmental Management Programme Report**
ESA	**Early Stone Age**
GPS	**Global Positioning System**
HIA	**Heritage Impact Assessment**
HIR	**Heritage Impact Report**
HSR	**Heritage Scoping Report**
I&AP	**Interested & Affected Party**
LSA	**Later Stone Age**
LIA	**Late Iron Age**
MSA	**Middle Stone Age**

MIA	**Middle Iron Age**
NEMA	**National Environmental Management Act**
NHRA	**National Heritage Resources Act**
PHRA	**Provincial Heritage Resources Authority**
PIA	**Palaeontological Impact Assessment**
PSSA	**Palaeontological Society of South Africa**
RoD	**Record of Decision**
SAHRA	**South African Heritage Resources Agency**

The following definitions are taken from the National Heritage Resources Act, no 25 of 1999 (NHRA, section 2):

Archaeological resources

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
iii. wrecks, being any vessel or aircraft, or any part thereof which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value.

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in the change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

4. LEGISLATIVE AND POLICY FRAMEWORK

4.1 Legislative Overview

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999

iii. Minerals and Petroleum Resources Development Act (MPRDA), Act 28 of 2002
iv. Development Facilitation Act (DFA), Act 67 of 1995

The following Acts refer directly to the identification, evaluation and assessment of cultural heritage resources:

i. National Environmental Management Act (NEMA), Act 107 of 1998:
   a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
   b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
   c. Environmental Impacts Assessment (EIA) – Section (32)(2)(d)
   d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA), Act 25 of 1999:
   a. Protection of Heritage resources – Sections 34 to 36; and
   b. Heritage Resources Management – Section 38
iii. Minerals and Petroleum Resources Development Act (MPRDA), Act 28 of 2002:
   a. Section 39(3)
iv. Development Facilitation Act (DFA), Act 67 of 1995:
   a. The GNR.1 of 7 January 2000: Regulations and rules in terms of the Development Facilitation Act, 1995. Section 31.

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, “no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…” The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA and the DFA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008b):

The NEMA 23(2)(b) states that an integrated environmental management plan should, “…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”.

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b)and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of

the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 (Fourie, 2008b).

MPRDA defines 'environment' as it is in the NEMA and therefore acknowledges cultural resources as part of the environment. Section 39(3)(b) of this Act specifically refers to the evaluation, assessment and identification of impacts on all heritage resources as identified in Section 3(2) of the National Heritage Resources Act that are to be impacted on by activities governed by the MPRDA. Section 40 of the same Act requires the consultation with any State Department administering any law that has relevance on such an application through Section 39 of the MPRDA. This implies the evaluation of Heritage Assessment Reports in Environmental Management Plans or Programmes by the relevant heritage authorities (Fourie, 2008b).

In accordance with the legislative requirements and EIA rating criteria, the regulations of the South African Heritage Resources Agency (SAHRA) and Association of Southern African Professional Archaeologists (ASAPA) have also been incorporated to ensure that a comprehensive and legally compatible HSR report is compiled.

The heritage impact assessment criteria to be utilised in the HIR are described in more detail in ***Annexure A***; while the Environmental Impact Scoring criteria to be utilised in the HIR, are provided in ***Annexure B***.

5. TECHNICAL DETAILS OF THE PROJECT

The Pembani Coal Mine is an existing mine of Pembani Coal Carolina (Pty) Ltd and has been in operation for some time. The mine is located on adjacent properties to the farm Zandvoort and the purpose of this new project is for the mine to incorporate the farm Zandvoort into their mining right. The mining on Zandvoort will only be undertaken by underground methods. The project is in the process of doing an amendment process (Section 1023 process) to incorporate Zandvoort into their existing mining right. The proposed underground coal mining development will comprise "*…mechanised or conventional bord and pillar mining methods (Continuous Miners or drill and blast), with no pillar extraction (to be confirmed) on retreat. In mechanised or conventional bord and pillar mining, extraction is achieved by developing a series of roadways (bords) in the coal seam and connecting them by splits (cut-throughs) to form pillars. These pillars are left behind as part of primary roof support system. In partial pillar extraction, every alternative pillar left behind (Known as Checker Bord extraction) to support the overburden or all the pillars are extracted (Stooping) to allow the roof to collapse in a controlled manner. The safety factor to support the overburden is scientifically calculated by the geotechnical engineer* (ECMA Consulting, 2015).

The underground mining of the farm Zandvoort 10 IT forms part of a much bigger coal mining project which includes both underground and opencast mining operations. No surface impacts are proposed for the farm Zandvoort 10 IT

with access to the target coal seams obtained from neighbouring properties. The coal seams that are to be mined are B Seam (at an average depth 27.6 meters) and E Seam (at an average depth 53 meters).

6. GENERAL BACKGROUND TO THE STUDY AREA AND SURROUNDING LANDSCAPE

6.1 Historical and Archaeological Overview of the Study Area and Surrounding Landscape

The province of Mpumalanga is known to be rich in archaeological sites that tell the story of humans and their predecessors in the region going back some 1.7 million years (Delius & Hay, 2009). The archaeological history of the area can broadly be divided into a Stone Age, Iron Age and Historic Period. Both the Stone and Iron Ages form part of what is referred to as the Pre-Colonial Period (Prehistoric Period) whereas the Historic Period is referred to as the Colonial Period (Historic Period). The archaeological and historical overview of the study area and surrounding landscape is summarised in a chronological manner in table form below. Although this area would have been well suited for human habitation over the last 1.7 million years, very little information is known about especially the archaeological history of the area. This can likely be attributed to a lack of research focus in this area over the past half a century or more and does not necessarily mean that no such sites exist within this area. This said, there has however been an increasing amount of focus on especially the Late Iron Age communities in the wider surroundings of the study area.

Early research conducted on the Late Iron Age in Mpumalanga include the 1912 descriptions of Trevor and Hall regarding prehistoric copper, gold and iron mines in the Mpumalanga region (Evers 1975). Within a few decades the first archaeological research on Late Iron Age sites along the escarpment was undertaken by Laidler in 1932 and Van Hoepen in 1939. In 1950, Revil Mason initiated the Transvaal Iron Age Project, which subsequently launched large-scale excavations and topographic surveys of Iron Age or farming community sites in South Africa with the aim of uncovering possible behavioural evidence. The latter was achieved by finding and investigating material artefacts and their spatial disposition on sites, together with the associated food waste deposits and the topographic location of living sites (Mason 1968). This project became the basis for the planning of a programme of future fieldwork as previous research on farming community sites was limited and inadequately controlled (Maggs 1974).

Following the initiation of the above mentioned project, Mason (1968) carried out an extensive aerial survey of the area, one of the first of its kind in the Mpumalanga area. Mason believed that this method would be the best way to conduct the Transvaal Iron Age Project. The photographs for this survey were taken by the South African Air Force and from the series of images gathered, Mason concluded that walled sites were generally located on high ground and concentrated in drainage areas, which is thought to have facilitated the watering of cattle. Mason (1968) presumed that the behaviour of the farmers of that time was linked to the environmental variations existing between the different areas. Evers (1973, 1975) subsequently contributed to Mason's research by conducting another aerial survey of the area between Lydenburg and Machadodorp. These images revealed that the sites were generally clustered

unevenly on the eastern slopes of hillsides. However, this site distribution pattern is not ubiquitous throughout the area, as research undertaken by Collett (1982) in the Badfontien Valley shows sites situated on western facing slopes. It can thus be concluded that the determining factor in site location was water availability rather than the placement of sites on specific sides of ridges (Collett 1982).

When observing the history of Mpumalanga over the past 1 000 years it is evident that the Late Iron Age agro-pastoralists migrated to the area when climatic conditions became better suited to their agricultural needs (Huffman 2007). These populations had obtained new improved methods of agriculture when compared with Early Iron Age communities (EIA) that previously resided in Southern Africa. These improved methods are evident when observing the terraced agriculture and substantial increases in the number of cattle as suggested by the unusually large kraals on the escarpment (Angel 2014). The latter can be seen on Google images.

Delius (2007) mentions that from around the beginning of the sixteenth century Late Iron Age communities would have migrated to Mpumalanga during times of climate shift and political instability. At around 1640, during a warmer phase within the Little Ice Age, the population growth showed a considerable increase. As the population increased, the frequency of interactions dealing with land and resources between various groups also intensified. Furthermore, it is believed that climatic conditions, agricultural potential and trade networks would have further intensified these social interactions among the Late Iron Age people (Angel 2014).

Maggs (1976) opines that the Highveld areas of Mpumalanga were not occupied by the Early Iron Age due to the existing environment. The extensive grassland endemic to this area was of little value to their economy as they were dependent on slash-and-burn (swidden) agriculture. Radiocarbon dating from pottery places the EIA in the first millennium (Evers 1977); however, the land became valuable only when LIA populations had increased livestock numbers to the point that they formed a principal resource. It is during this time that the LIA populations would have migrated to the high grasslands of the Highveld to take advantage of the open grazing lands (Hall 1987).

There is some debate over which cultural group occupied the Highveld and the escarpment during the last 500 years. The most common assumption is that the area was dominated by an essentially Pedi culture during the second millennium (Mason 1963). However, it is now believed by some that the BoKoni were responsible for the terracing and road networks in the area (see for example Maggs, 2008, Delius and Schoeman 2007, Huffman 2007). Oral traditions have also placed the Koni in the escarpment area before the Pedi (Huffman 2008). If this is the case, some sites would be dated around AD 1600-1650 (Huffman 2007). According to Huffman (2007), the Koni are “Sotho-ised Nguni” with the word Koni meaning Nguni in the Sotho-Tswana language.

It is therefore not entirely clear who occupied the sites and when, but it can be assumed that the sites were not all occupied simultaneously nor were they occupied permanently (Angel 2014). It is also likely that the terracing

agriculture only occurred seasonally, with farmers utilising the warmer climate at higher altitudes without the threat of disease (Angel 2014). Political strife may also have led to an abandonment of sites. Delius and Schoeman (2007) mention two violent periods, the first in the seventeenth century and the second in the mid eighteenth century which may well have led to the abandonment of the Komati River Valley. As stated previously, times of occupation were also uncertain. Some oral sources state that the Maroteng (who later established the Pedi Kingdom) settled in the area in 1650 (Delius and Schoeman 2008). However, according to Delius and Schoeman (2007), Pedi tradition relates that Koni groups were encountered when the Maroteng first moved into the area which suggests that the area had been occupied since the early 1600s. Other evidence of occupation includes documents of active trade within the area. The 1810s and 1820s are reputed to have been a time when "as the tempo of political change accelerated in the wider region, it seems likely that a municipality of groups travelled, raided and even settled for periods of time in Mpumalanga" (Delius and Schoeman 2007: 150). Lastly, missionary sources place occupation of the area at 1860 (Delius and Schoeman 2007).

Archaeological evidence suggests that the EIA in the Lowveld area would have continued to exist until the fifteenth century AD, while it ceased to exist on the Highveld by AD 1100. The Highveld area, according to Esterhuysen and Smith (2007), became active again from the fifteenth century onwards. The LIA sites of this period can be recognised by their extensive stone walled settlements that appear to have occurred from AD 1400 to the mid nineteenth century, ending with the Difaqane and thereafter succeeded by European occupation (Marker and Evers 1976).

Scholfield (1935, 1936, 1948), Dart and Beaumont (1969), Beaumont and Vogel (1972) and Maggs (1973) observed and documented a range of different walled sites in Mpumalanga. The complex terraced and stone walled sites found between Ohrigstad and Carolina in particular caught their attention. Yet, despite repeated studies to understand these unique sites, many questions remain unanswered, including who built the sites and why. This area of closely situated pre-colonial stone ruins extends along the escarpment, which separates the Lowveld from the Highveld in the Mpumalanga Province (Maggs 2008). In comparison with the Early Iron Age, the Late Iron Age had a substantially larger population and the sites are accordingly significantly bigger. These more extensive sites include agricultural land defined by terraces as well as trade and social networks in the form of cattle tracks (Marker and Evers 1976, Delius and Schoeman 2008). According to Marker and Evers (1976), the most prominent differences between the occupations of the LIA and that of the EIA in this area are that the LIA possessed more livestock, and terracing agriculture was initiated during their occupation.

Delius and Schoeman (2008) argue that terracing represents a difference in agricultural strategy and the extent of terracing seen in this area suggests that the aim was production beyond local need. Likewise, the extensive cattle control measures exercised here, such as cattle paths designed to prevent crops from being trampled, indicate that large numbers of cattle were present (Delius and Schoeman 2008). Maggs (2008) also emphasises the extent of the terraces and the networks of linking roads. He believes that the terraces represent one of the only South African field

systems that survived from pre-colonial times. He also compares this terracing method with that of eastern Africa, claiming that the thousands of hectares of terraces and long distance roads represent a massive investment in landesque capital. This infrastructure would also have required a substantial mobilisation of labour and it is the scale of this investment that sets the BoKoni apart from other pre-colonial societies in South Africa (Maggs 2008: 179).

A screening of the available Google Earth imagery depicting the study area and surrounding landscape was made and while no Late Iron Age stone walled settlements are evident from within the study area and its direct surroundings, large numbers of such settlements were identified roughly 2.7 km north-west of the study area.

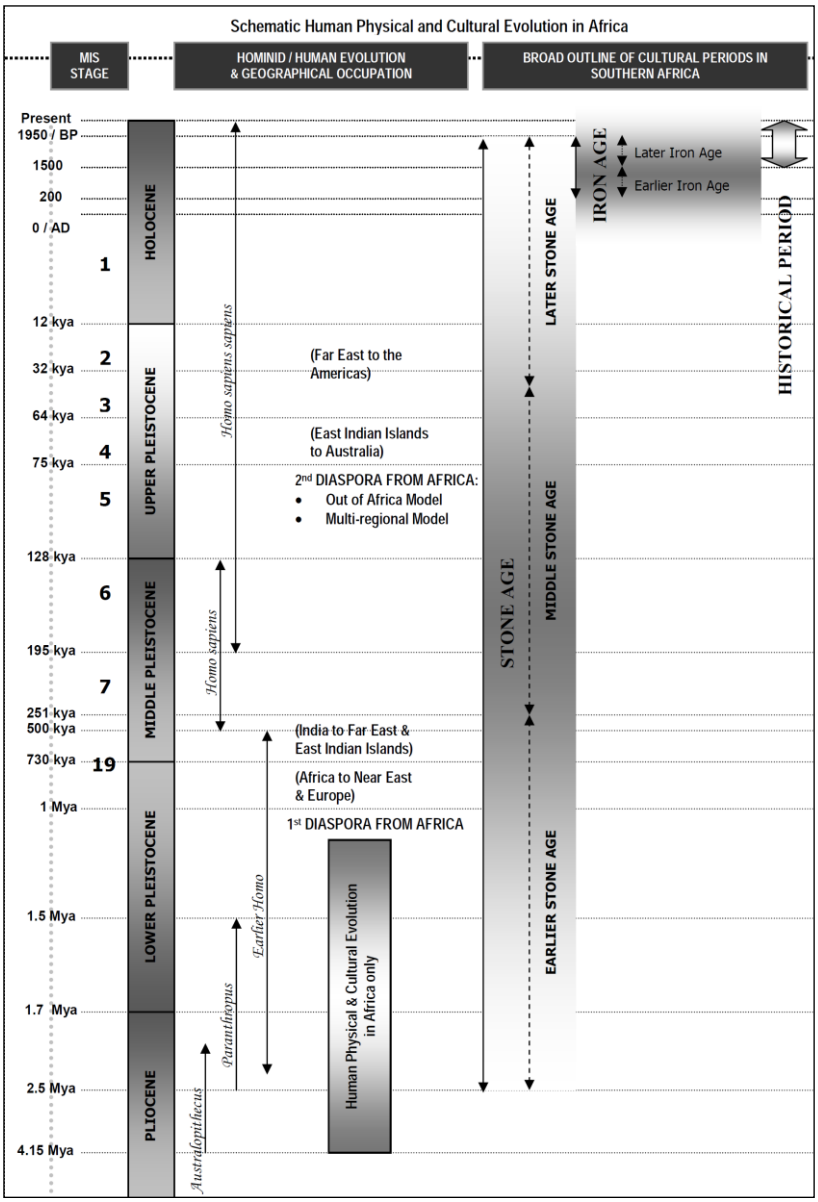

Figure 2 – Human and Cultural Time line in Africa (Morris, 2008)

Table 2- Archaeological and Historical Overview of the Study Area and Surrounding Landscape

DATE	DESCRIPTION

2.5 million to 250 000 years ago	The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these is known as Oldowan and is associated with crude flakes and hammer stones. It dates to approximately 2 million years ago. The second technological phase is the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates back to approximately 1.5 million years ago. No Early Stone Age sites are known from the study area or direct vicinity. This is more than likely rather due to lack of research focus in this area than an absence of such sites.
250 000 to 40 000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. This phase is associated with flakes, points and blades manufactured by means of the so-called 'prepared core' technique. No Middle Stone Age sites are known from the study area or direct vicinity. This is more than likely rather due to lack of research focus in this area than an absence of such sites.
40 000 years ago to the historic past	The Later Stone Age is the third archaeological phase identified and is associated with an abundance of very small artefacts known as microliths. Later Stone Age sites, including rock paintings, are known from the farm Groenvlei in localities roughly 5 m east of Carolina (Van Niekerk, 1984) (Bergh, 1999). The farm Groenvlei (or Groenvallei) is located adjacent and directly south of Zandvoort. These sites are estimated to be located roughly 3.4 km directly south of the present study area.
AD 280 – AD 450	The earliest phase in the Iron Age history of Southern African is known as the Early Iron Age. According to the distribution maps published by Huffman (2007) the only possible presence of Early Iron Age sites in the study area and surrounding landscape would be in the form of the so-called Silver Leaves facies of the Kwale Branch of the Urewe Tradition. This facies is dated to between AD 280 and AD 450. The key features on the decorated ceramics of the Silver Leaves facies comprise multiple facets in the first position (Huffman, 2007).
AD 1650 – AD 1840	The second phase in the Iron Age history of the study area and surrounding landscape is in the form of the Marateng facies of the Moloko Branch of the Urewe Tradition. The key features in the decorated ceramics of the Marateng facies are incised arcades on upper shoulder separating black and red (Huffman, 2007).
c. 1800	At the time a group of people known as the Phuthing were living in the wider surroundings of the present study area (Bergh, 1999). According to this author the Phuthing were at the time living in the watershed between the upper reaches of the Vaal and Olifants Rivers.
c. 1821	Across the Highveld this period was characterised by warfare and unrest. Known as the Mfecane, these years of upheaval originated primarily in the migration of three Nguni groups from present day Kwazulu-Natal into the present day Free State, North West, Gauteng and Mpumalanga as a result of the conquests of the Zulu under King Shaka. The three Nguni groups were the Hlubi of Mpangazitha, the Ngwane of Matiwane and the Khumalo Ndebele (Matabele) of Mzilikazi. Only the latter group is of relevance to the present study area and surroundings. The Khumalo Ndebele left present day Kwazulu Natal and moved through the general vicinity of the present study area. In this general area they attacked the Phuthing who fled southward across the Vaal River (Bergh, 1999).

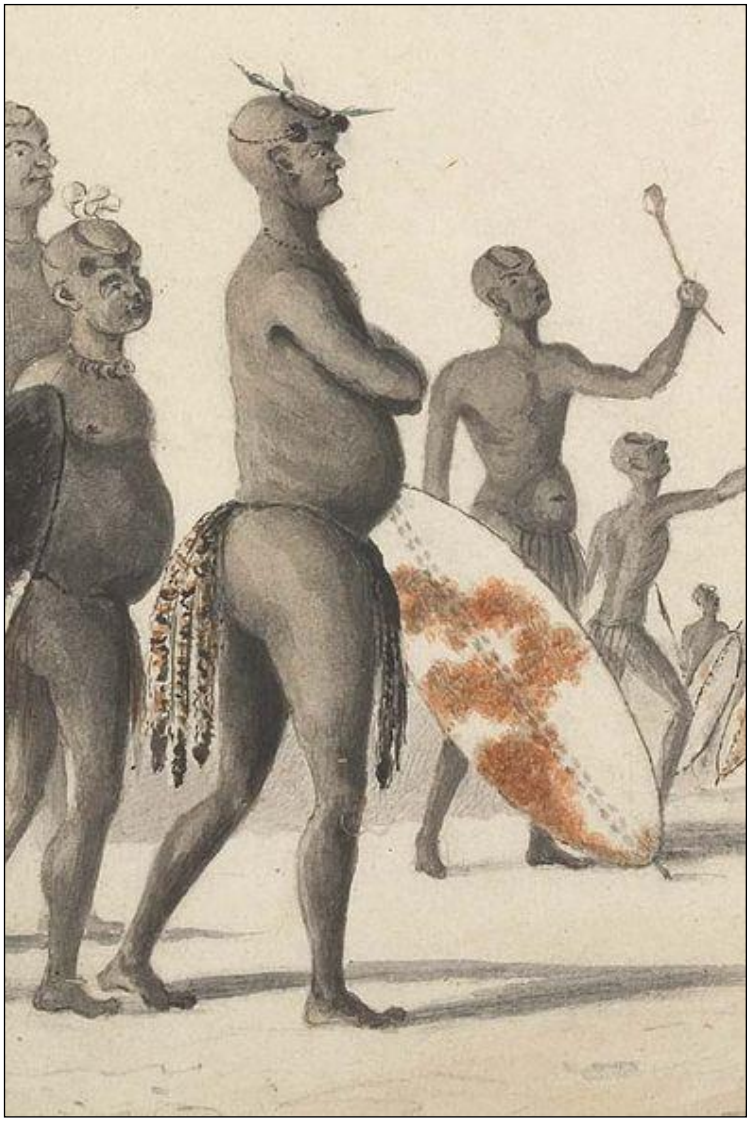

Figure 3

King Mzilikazi of the Matabele. This illustration was made by Captain Cornwallis Harris in c. 1838 (www.sahistory.org.za).

1836 – 1850	Although the first Voortrekker parties started crossing over the Vaal River in 1836, the years 1839 to 1840 saw the first widespread settlement of Voortrekkers north of the Vaal River in an area which encompasses the south-eastern end of the North West Province and the western end of Gauteng. Early towns such as Klerksdorp, Potchefstroom, Rustenburg and Pretoria were all included in this first settlement area. Between 1841 and 1850 an expansion of settlement took place which included present day towns of Bronkhorstspruit in the east, Thabazimbi in the north and Rooigrond in the west (Bergh, 1999).
1845 – 1864	The district of Lydenburg was established in 1845 and the study area fell within this district (Bergh, 1999). It can be expected that the general surroundings of the study area would have increasingly being settled by Voortrekkers after the establishment of this district. The permanent settlement of white farmers in the general vicinity of the study area would have resulted in the proclamation of individual farms and the establishment of permanent farmsteads. Features that can typically be associated with early farming history of the area include farm dwellings, sheds, rectangular stone kraals, canals, farm labourer accommodation and cemeteries. While very few heritage sites associated with the very first establishment of white farmers in the study area would likely still be found, a number of farmsteads dating from the 1880s and 1890s are likely still in existence in the general vicinity of the study area.

	The other sites often associated with these early farms are graves and cemeteries for both white farmers and black farm labourers. A large number of such cemeteries are located in the general vicinity of the study area.
16 November 1864	The farm Zandvoort was inspected by J. J. H. Steyn (National Archives, RAK, 3082). It is possible that this person was Jacobus Johannes Hercules Steyn (11 June 1837 – 27 August 1893) who appears to have been a resident of the Lydenburg district (see for example www.geni.com) and may have been responsible for the inspection of the farm at a time when it still fell within the Lydenburg district. If this assumption is correct, then Jacobus Johannes Hercules Steyn would in all likelihood have been a veldkornet or commandant. At the time the farm was proclaimed as Zandvoort number 306 of the Lydenburg District (National Archives, RAK, 3082).
3 August 1869	The farm Zandvoort was transferred to its first owner, Gerhardus Theodorus Becking (National Archives, RAK, 3082). While no information is presently known about Mr. Becking, his surname suggests a strong Dutch association or origin. It is therefore quite likely for the farm name Zandvoort to have originated with the property's very first owner.
1872 - 1894	During the early 1870s the general vicinity of Witbank was visited by a geologist from Eastern Europe Woolf Harris. During his visit Harris identified coal in the Van Dyksdrift area. He is also believed to have started the Maggie's Mine the following year. Following on these discoveries and events, a number of small coal mining operations were started in the general vicinity of Witbank as well. By 1889 there were four coal mines in the Witbank area, namely Brugspruit Adit, Maggie's Mine, Steenkoolspruit and Douglas (Falconer, 1990). No coal mines are known from the Carolina area at this early point in time.
10 January 1876	The farm Zandvoort was transferred to James Martin Williams (National Archives, RAK, 3082) roughly six years after the death of its first owner Gerhardus Theodorus Becking in 1870 (National Archives, MHG, 0/19328).
7 February 1876	Less than a month after obtaining the farm, James Martin Williams divided Zandvoort into two portions. One portion was transferred to Frans Coenraad Dekker with another going to Richard Thomas Nicolaas James (National Archives, RAK, 3082). No information could be found on these two individuals.
2 December 1879	The portion of the farm Zandvoort belonging to Frans Coenraad Dekker was transferred to the Lydenburg Branch of the Cape Commercial Bank (National Archives, RAK, 3082).
9 March 1880	The portion of the farm Zandvoort belonging to Richard Thomas Nicolaas James was transferred to William Palframan (National Archives, RAK, 3082). It would appear that the person referred to here was William Palfaram who had been born in Binkin, North Yorkshire, Great Britain in c. 1924 and died on 4 August 1905 in Pietermaritzburg, Kwazulu Natal (www.geni.com).
7 December 1880	The share of the farm Zandvoort belonging to the Cape Commercial Bank was transferred to Hermann Ludwig Eckstein (3 August 1847 – 16 January 1893) (National Archives, RAK, 3082). Eckstein immigrated to South Africa from Germany in 1882 and became manager of the Phoenix Diamond Mining Company at Du Toit's pan in Kimberly. In 1884 he joined the partnership of Jules Porges & Co which later became known as Wernher, Beit & Co. The company was intensively involved in the Barberton and De Kaap goldfields. In 1888 Eckstein started his own firm namely Hermann Eckstein and Co. It was during this early phase in the existence of Hermann Eckstein and Co. that he acquired the portion of the farm Zandvoort. While it is certain that Eckstein would not have bought

	the farm with the intention of living there (his business interests were more orientated towards Johannesburg,), it may have been acquired for farming purposes or alternatively for coal. Amongst many accomplishments, Eckstein is known to have established the Chamber of Mines in Johannesburg and acted as its president until 1892. He was also one of the leading role players in the mining development of the Witwatersrand and the Transvaal Republic. In 1903, a decade after his death, Eckstein's former partners made a gift to the City of Johannesburg of a portion of land known as the Sachsenwald. This land presently includes Saxonwold, Forest Town, Zoo Lake and the Johannesburg Zoo. At the time, the area which today encompasses the Johannesburg Zoo and Zoo Lake was known as the Hermann Eckstein Park in honour of this historic figure.

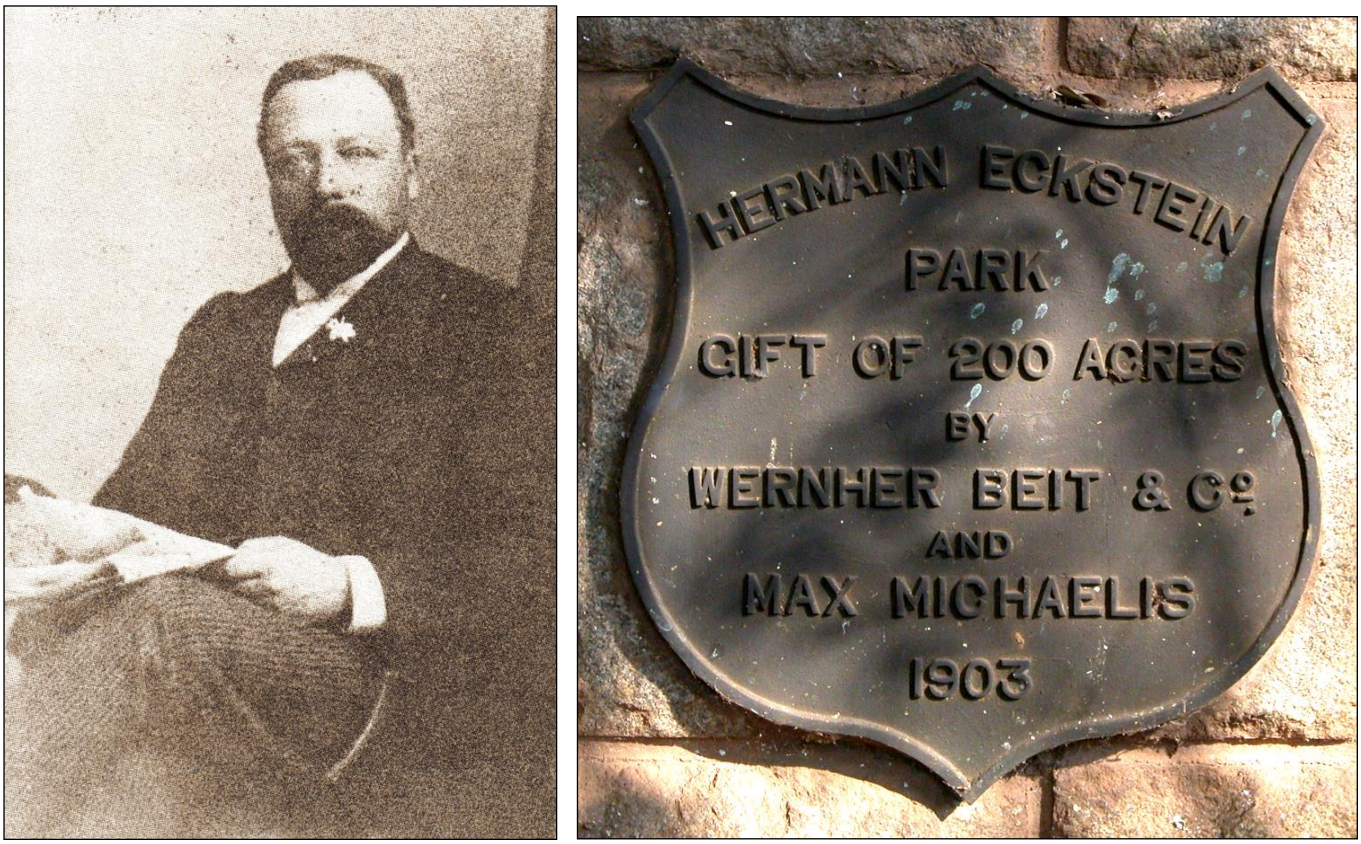

Figure 4 –The image on the left is a historic portrait of Hermann Ludwig Eckstein (Johannesburg City Council, 1986:15) whereas the photograph on the right depicts a plaque at the Johannesburg Zoo commemorating the gift by Wernher Beit & Co. as well as Max Michaelis of a portion of land in the name of Hermann Eckstein which led to the establishment of the Johannesburg Zoo.

26 October 1882	The district of Ermelo was proclaimed (Bergh, 1999). The study area would now fall within this district for the next 11 years.
16 June 1886	The town of Carolina was officially proclaimed on this day (Myburgh, 1956) and was proclaimed on the farms Groenvlei and Goedehoop owned by Cornelius Johannes Coetzee. The name of the town is in honour of Coetzee's wife namely Magdalena Carolina Smit.

4 February 1890	The portion of the farm Zandvoort belonging to W. Palframan was transferred to another well known late nineteenth century Transvaal businessman named Alois Hugo Nellmapius (5 May 1847 – 27 July 1893) (National Archives, RAK, 3082). Nellmapius was born in Budapest, Hungary and after the discovery of gold in the eastern Transvaal Republic gave up a promising career as a civil engineer to follow a path of business and fortune in Africa. He arrived in Pilgrims Rest in 1873 and within a short spate of time became successful. At first he ran a successful mule caravan service between the Highveld and Delagoa Bay and also had a successful business of merchant of contraband Portuguese liquor in Pilgrims Rest. However, Nellmapius also had much success in farming and became the owner of large tracks of land, including a farm just south of Pretoria that he named Irene after his daughter (Webster 2002). With time Nellmapius became a friend and confidant of President Paul Kruger and also suggested to Kruger to start implementing concessions. On 3 October 1881 the Republican Volksraad granted Nellmapius the concession for the "...*sole right to manufacture from grain, potatoes and other products growable in the Transvaal, with the exception of tree fruits and grapes, and the right to sell in bulk and bottle free of licence such spirits*." (Webster 2002).This concession was granted for a period of fifteen years which made Nellmapius the only legal licensed producer of spirits in the Transvaal. On 17 June 1882 Nellmapius ceded this concession to a partnership consisting of himself, cousins Isaac and Barnard Lewis and Barnard's brother in law, Samuel Marks (Webster 2002). This laid the foundation for the first liquor distillery in the Transvaal Republican known as De Eerste Fabrieken and in June 1883 President Paul Kruger opened the new distillery and christened it 'Volkshoop' (the Nation's Hope) (Webster 2002).
 *Figure 5* *Alois Hugo Nellmapius (Kaye, 1978).*	
11 June 1892	Hermann Ludwig Eckstein transferred his portion of Zandvoort to the Transvaal Consolidated Land & Exploration Company Limited (National Archives, RAK, 3082). Incorporated in the 1870s, this company became one of the significant players in the Transvaal Republic as a land company. By the end of the nineteenth century the company owned as many as 656 farms in the Transvaal Republic (Bonner, 2002).

21 December 1893	The district of Carolina was established on this day (Bergh, 1999). The study area now fell within this district. It would remain in this district for at least the next 100 years.
4 November 1895	Alois Hugo Nellmapius transferred his portion of Zandvoort to the Landed Proprietary Company Limited (National Archives, RAK, 3082). Very little information could be found about this company.
31 December 1902	The Landed Proprietary Company Limited transferred their portion of Zandvoort to the Transvaal Consolidated Land & Exploration Company Limited (National Archives, RAK, 3082). According to a file found in the National Archives (LD, 184, AG6377/02) all the farms owned by the Landed Proprietary Company Limited were transferred to the Transvaal Consolidated Land & Exploration Company during the period between 1902 and 1904. When this transfer was completed it meant that for the first time since 7 February 1876 the farm was again owned by a single entity.
1899 - 1902	The South African War wreaked havoc across Southern Africa during this time. Although no record for any battles or skirmishes for the study area and its immediate surroundings could be located, a number of skirmishes and battles did take place in the surrounding landscape. On 14 August 1900 members of the Canadian force known as Stratchcona's Horse were about to occupy Carolina when they were fired upon by 14 Boers under the command of General Tobias Smuts. The skirmish took place in Dorp Street (Van der Westhuizen & Van der Westhuizen 2000) and the scene of the skirmish is located roughly 4 km south west of the present study area. Furthermore, on 7 November 1900, a battle took place at Leliefontein (the battle is also referred to as Witkloof). The farm Leliefontein is located roughly 10 km west by northwest of the present study area. Two senior Boer commanders at the battle, namely General Joachim Fourie and Commandant Hendrik Prinsloo were killed in a fatal frontal attack on a strong British position. Twenty-seven years after the battle, on 7 November 1927, General Smith-Dorrien, the British commander at the battle, erected a memorial on the battlefield in honour of Fourie and Prinsloo. The memorial was designed and built with funds raised from the public in Great Britain (Van der Westhuizen & Van der Westhuizen 2000).

Figure 6 – Kommandant Hendrik F. Prinsloo and General Joachem C. Fourie who were both killed during the battle of Witkloof. Kommandant Prinsloo owned the farm Hawerfontein located directly north-west of Zandvoort. After the battle he was buried on the farm and on 29 August 1970 was reinterred at Bergendal. The monument erected by General Smith-Dorrien in 1927 on the battlefield in honour of his adversaries can be seen on the right (Van der Westhuizen and Van der Westhuizn, 2000).

1904	In the Annual Report of the Government Mining Engineer for the year 1904 it is indicated that a coal mine of the Transvaal Consolidated Coal Mines Limited was already located on the farm Quaggafontein. This farm is situated directly adjacent to the present study area. The chairman of the Transvaal Consolidated Coal Mines Limited at the time was Amandus Brakhan, the manager of the mine was one J.W. Graves and the company secretary was P.W. Diamond.
6 March 1911	The Transvaal Consolidated Land & Exploration Company Limited transferred the farm Zandvoort to Johannes Gerhardus Albertus Davel (National Archives, RAK, 3082). The grave of Mr. J.G.A. Davel (17 August 1865 – 1 February 1923) is located in the historic cemetery on the farm (see Site 2). It also seems highly likely for at least the farm dwelling (see Site 4) to have been built and used by Johannes Gerhardus Albertus Davel. Johannes Gerhardus Albertus Davel was born in Caledon in the Cape Colony in 1865 (National Archives, MHG, 50848). While it is not exactly known when he moved to the Transvaal Republic, Davel married Hester Maria van Niekerk on 21 April 1897 (?) in Carolina (see for example www.geni.com). The couple had 10 children, of which the third eldest Johannes Gerhardus Albertus Davel was born in 1900. Incidentally, this child spent his early years in the Concentration Camp at Carolina. Between 1951 and 1965 J.G.A. Davel junior became Professor and Head of the Department of Paediatrics at the University of Pretoria and also dean of the Medical Faculty at the same University between 1961 and 1965 (www.up.ac.za/media/shared/Legacy/sitefiles/file/45/1335/877/upmedisyne50.pdf).

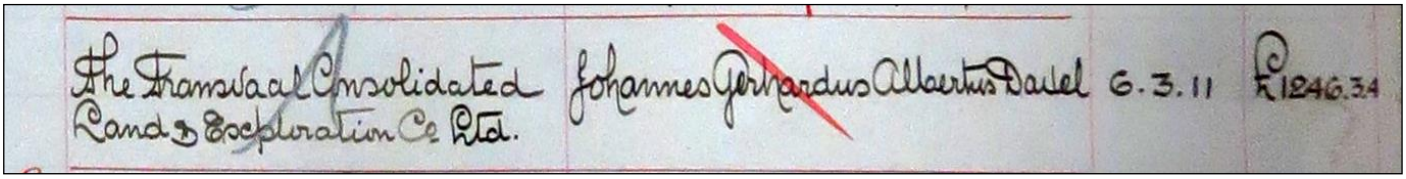

Figure 7 – Section of the farm ownership history located at the National Archives. This section shows the transfer of the farm from The Transvaal Consolidated Land & Exploration Company Limited to Johannes Gerhardus Albertus Davel on 6 March 1911 (National Archives, RAK, 3082). The farm was sold for an amount of £1246.34.

29 January 1926	In terms of the will of Johannes Gerhardus Albertus Davel, the eastern portion of the farm Zandvoort was transferred to the couple's fourth child namely Tobias Davel whereas the western portion of the farm was transferred to the couple's seventh child Wynand Jacobus Davel. Very little is known about Tobias Davel. Wynand Jacobus Davel lies buried with his parents in the cemetery located on the farm. From information obtained from his tombstone as well as his death certificate located at the National Archives (MHG, 826/41) it is known that he was born on the farm Groenvallei near Carolina on 27 April 1916 and passed away in the farmhouse at Zandvoort (see Site 4) on 25 February 1941 at the young age of 24 years and 10 months. Wynand Jacobus Davel lived in the farmhouse still located on the property in the years leading up to his death in 1941.
25 February 1941	As indicated above, on this day the owner of the western portion of the farm, namely Wynand Jacobus Davel passed away. At the time of his death he was unmarried and as a result his estate was divided amongst his mother and siblings. Although his estate was originally divided between 18 beneficiaries, the family jointly decided to redistribute the land owned by W. J Davel by eleven (National Archives, MHG, 826/41).
8 November 1943	On this day the portion of the farm Zandvoort owned by the late Wynand Jacobus Davel was divided between his mother Hester Maria Davel, brother (Professor) Johannes Gerhardus Albertus Davel, brother Tobias Davel and sister Maria Adriaana van Aardt (National Archives, RAK, 3082). Hester Maria Davel lies buried next to her husband Johannes Gerhardus Albertus Davel in the cemetery on the farm (see Site 2). She was born on 8 November 1870 in the Carolina District and passed away in the Zandvoort farmhouse (see Site 4) on 28 August 1945, four years after the death of her son.
29 November 1945	The portion of land awarded to M. A. van Aardt was transferred to Tobias Davel (National Archives, RAK, 3082).
1949	By this year coal mining and production was already in progress on three farms located adjacent to Zandvoort, namely Quaggafontein, Groenvalei and Paardeplaats (Myburgh, 1956).
21 February 1949	On this day the portion of the western portion of the farm Zandvoort which had been held by Hester Maria Davel was also transferred to Tobias Davel. This means that with the exception of the portion owned by his brother, Professor Johannes Gerhardus Albertus Davel, the farm was almost entirely owned by Tobias Davel (National Archives, RAK, 3082).
1950s	The Kwaggafontein Colliery located on the farm Quaggafontein is mentioned in a number of reports from the mid to late 1950s. At the time, a graphite mine was also in operation on the farm Twyfelaar. This farm is located directly north of the farm Zandvoort.

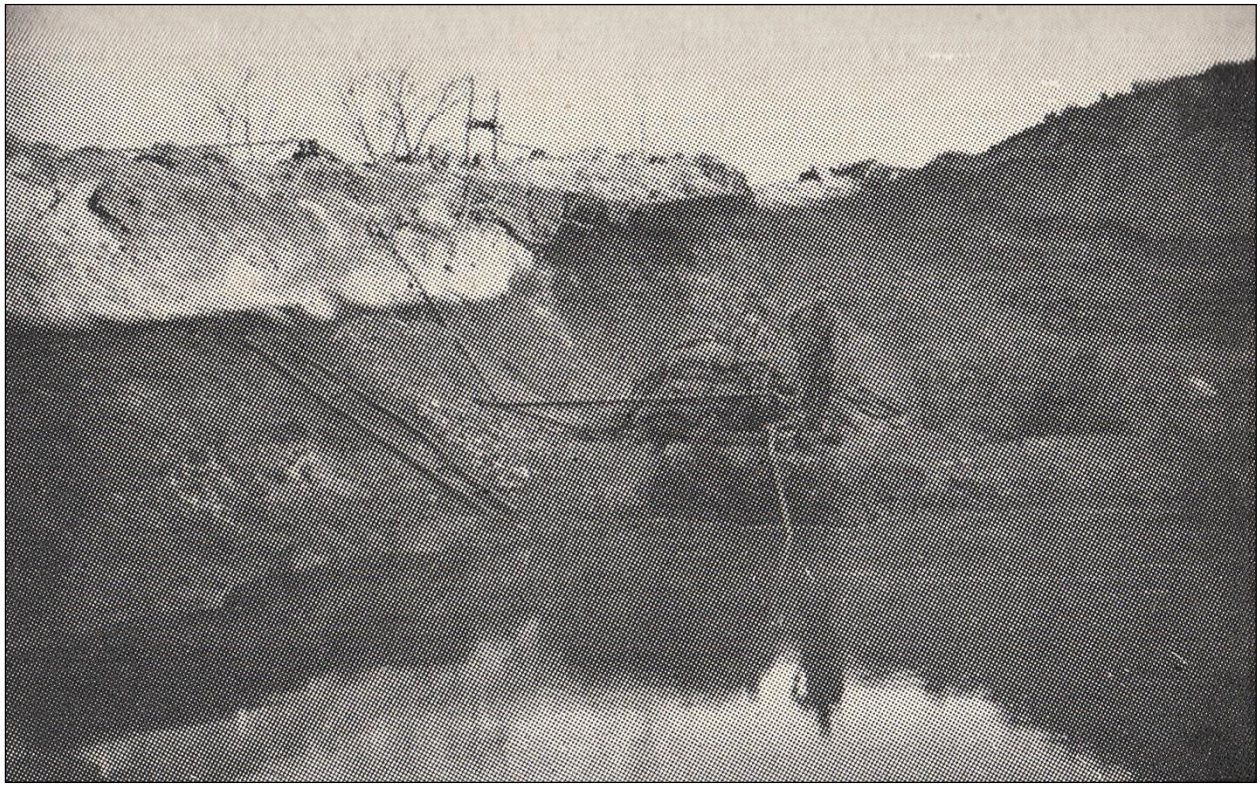

Figure 8 – This graphite mine was in operation on the farm Twyfelaar during the 1950s (Myburgh, 1956).

1962	Nooitgedacht Dam was built in 1962 (Fourie, 2014) as part of the Upper Komati River Government Water Scheme. The dam is located 7.5 km north-west of the present study area.
1980	The Nooitgedacht Dam Nature Reserve was established in 1980 and at the time fell under the management of the Transvaal Provincial Administration (Bergh, 1999). The nature reserve is located roughly 5.5 km north-west of the present study area.

6.2 Examination of Archival and Historic Maps

6.2.1 Survey Diagram compiled in 1896 for the Farm Zandvoort

The image below depicts a section of the Survey Diagram for the farm Zandvoort that was compiled on 30 July 1896. The survey diagram was compiled for the two owners of the farm at the time namely the Landed Proprietary Company Limited and the Transvaal Consolidated Land & Exploration Company Limited. The boundaries of the farm were confirmed in the field with neighbouring landowners during September 1895. The diagram is signed by Johann Rissik, the Surveyor General of the *Zuid Afrikaansche Republiek*.

The following observations can be made from the map:

- No heritage sites or features are depicted within the boundaries of the farm Zandvoort.
- A number of roads are shown crossing over the farm.

- A “grasspannetjie” or grass pan is depicted on the south-western corner of the farm.

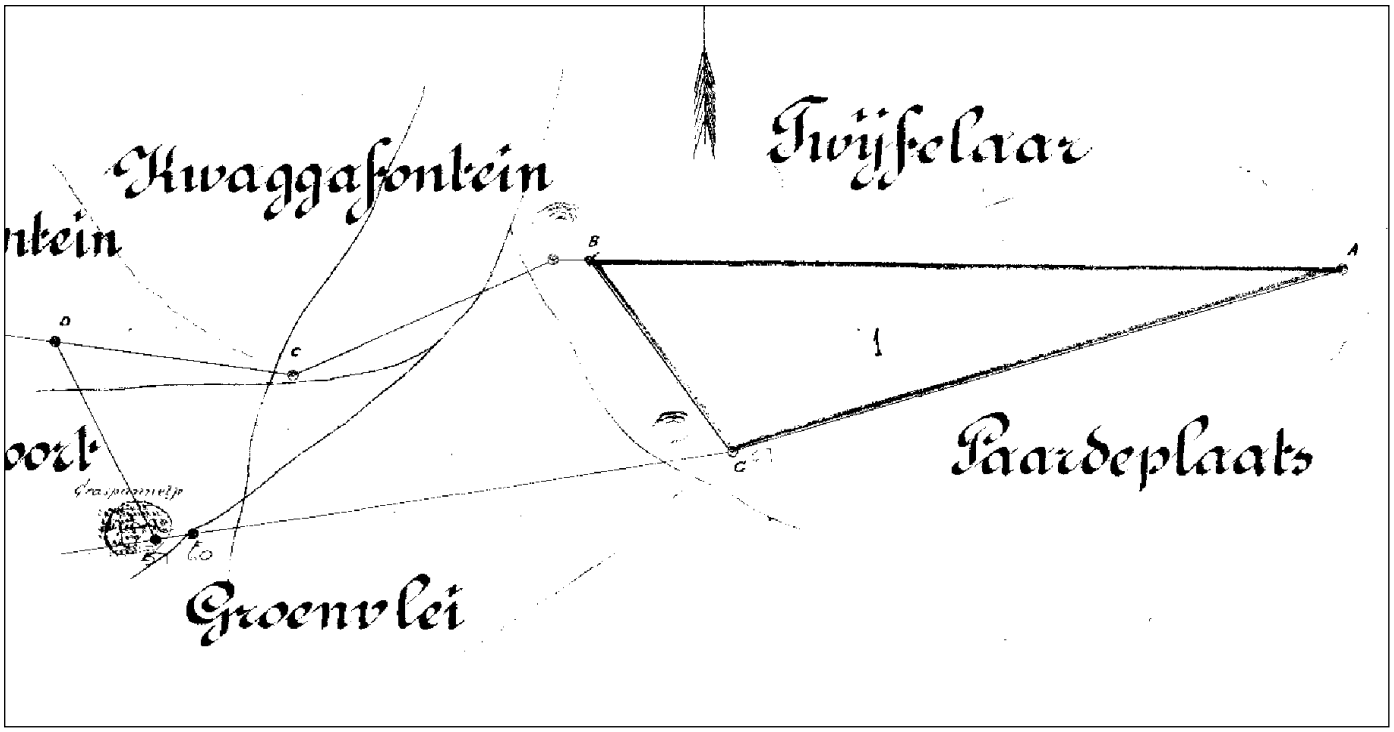

Figure 9 – Section from the 1896 Survey Diagram for the farm Zandvoort.

6.2.2 Ermelo Sheet of the c 1913 Transvaal and Orange River Map Series

The image below depicts a section of the Ermelo sheet of the Transvaal and Orange River Map Series (National Archives, Maps, 31124) that was likely produced in 1913.

The following observations can be made from the map:

Feature 9

Feature 8

- No heritage features are depicted within the boundaries of the farm Zandvoort.
- A local wagon road is shown crossing diagonally through the farm. This road appears to have provided a link between the town of Carolina to the south and the farms to the north and represented one of two roads at the time between Carolina and Machadodorp.

- A farm track is shown running across the latter wagon road and ending near the top centre of the western half of the farm. As the place where this track ends is not anywhere near the known position of the farmstead, the function of this track is not presently clear.
- A railway line is shown passing directly west of the farm. This line was built between 1906 and 1910 (Bergh, 1999).

Figure 10 - Ermelo Sheet of the c 1913 Transvaal and Orange River Map Series (National Archives, Maps, 31124). No evidence for possible heritage features or sites are depicted on the map.

6.2.3 First Edition of the 2630AA Topographical Sheet

The image below depicts a section of the First Edition of the 2630AA Topographical Sheet. It was based on aerial photography undertaken in 1956 and was surveyed in 1968. The sheet was drawn in the Trigonometrical Survey Office in 1969.

The following observations can be made from the map:

- A farmstead comprising two buildings (see red arrow) is shown in the same place where the Zandvoort farmstead is still located today. From overlays made on Google Earth it is evident that the two buildings depicted on this map are the farmhouse and shed. This does not necessarily mean that the other buildings

such as the rondavel and wagon shed were not in existence at the time of the aerial photography and map surveying.

- The remnants of the original wagon road appear to be depicted on the map.
- The remnants of the original farm track appear to be depicted on the map. However, by this time the farmstead had a new access road linking it to the nearby gravel road.

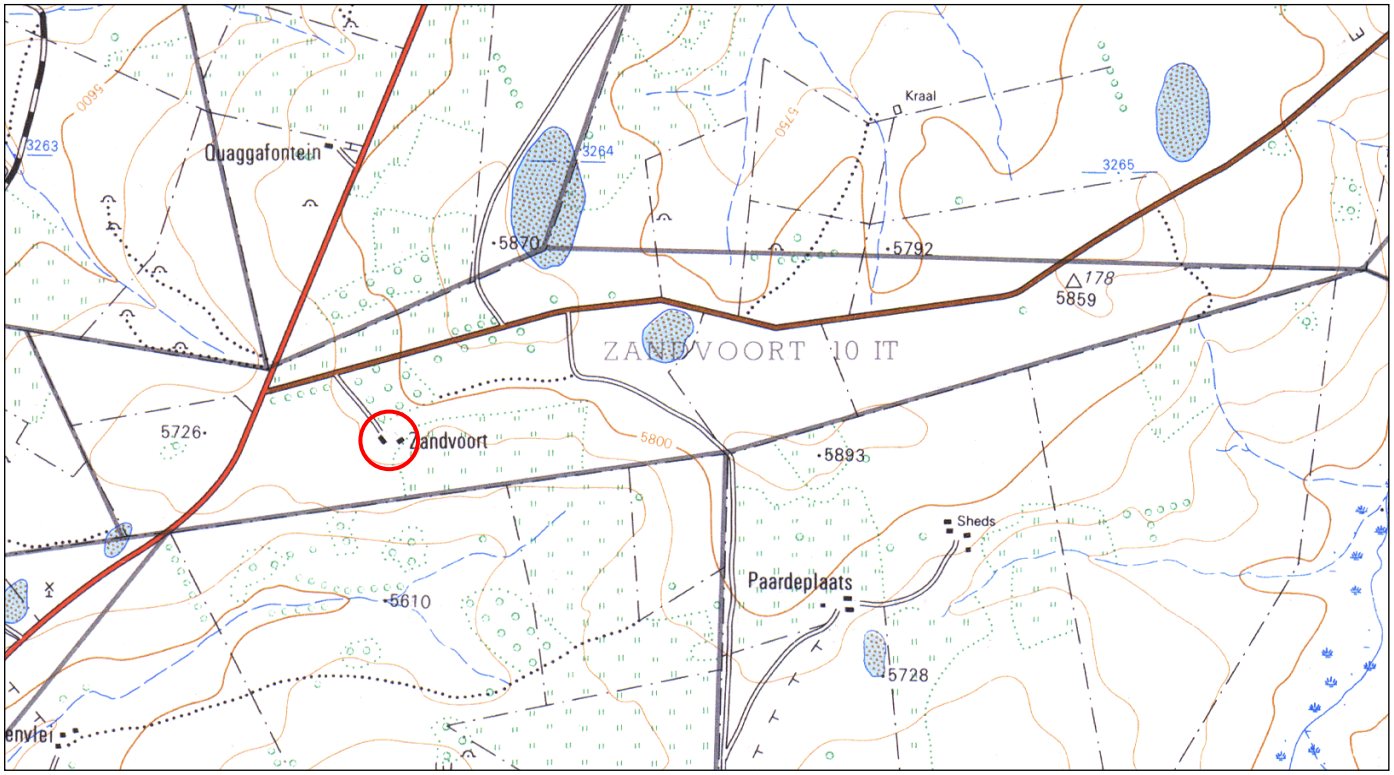

Figure 11 – First Edition of the 2630AA Topographical Sheet that was based on aerial photography undertaken in 1956 and that was surveyed in 1968.

6.3 Previous Archaeological and Heritage Studies undertaken within the Study Area

As far as could be established, no known archaeological or heritage studies have ever been undertaken within the study area. The South African Heritage Resources Information System (SAHRIS) contains no information on previous reports, permit applications and the like with regard to this farm. Only one previous study could be located on SAHRIS which was undertaken in the immediate vicinity of the study area.

- Van Vollenhoven, A. 2014**. A Report on the Assessment of Grave Sites at the Pembani Colliery close to Carolina in the Mpumalanga Province.** Commissioned by Cabanga Concepts. SAHRIS Case ID is 4589.

  This report included six cemeteries previously identified on farms located directl the present study area. None of these cemeteries are located directly adjacent to the present stu closest

Feature 5
Feature 6
Feature 7
Feature 10

cemetery to the present study area is the report's Site 6 and contains 25 graves belonging to the Becking, Schoeman, Versveld and Joubert families. This cemetery is located 545 m south of the present study area.

A number of archaeological and heritage assessments have been undertaken in the general vicinity of the study area. The typical heritage sites identified in these reports comprise cemeteries, farm buildings and Late Iron Age stonewalled sites (see for example Van Schalkwyk, 2007).

6.4 Archival Research in terms of the Study Area

The archival research undertaken at the National Archives in Pretoria revealed aspects relating to the farm ownership history of Zandvoort, death certificates and estate details for the individuals buried in the cemetery on the property as well as early maps of the study area and surroundings. These aspects are discussed in more detail in the historic overview provided above.

6.5 Palaeontological Desktop Study

A palaeontological desktop study was commissioned from Dr. Gideon Groenewald and represents the final component of the desktop study. His report indicates that the study area is mainly underlain by Permian aged rocks of the Dwyka Group and Vryheid Formation, Ecca Group, Karoo Supergroup and Jurassic aged dolerite sills. The palaeontology of the study area is described as follows in the report:

- **Dwyka Formation**

  Trace fossils have been described from the Dwyka Formation. The trace fossils are associated with the shale beds in the Formation.

- **Vryheid Formation**

  The Permian aged Vryheid Formation is mainly interpreted as a sandy shore deposit and fossils are mainly associated with event beds, with the commonest fossils being sparse to locally concentrated assemblages of trace fossils and abundant plant fossils (Johnson et al 2006). Body fossils are very rarely recorded.

  The Vryheid Formation is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) from the Vryheid Formation are; *Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Glossopteris > 20 species, Hirsutum 4 spp., Scutum*

4 spp., Ottokaria 3 spp., Estcourtia sp., Arberia 4 spp., Lidgetonnia sp., Noeggerathiopsis sp. and Podocarpidites sp.

According to Bamford (2011), little data has been published on these potentially fossiliferous deposits. Good fossil material is likely around the coal mines and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites. In the interests of heritage and science, however, such sites should be well recorded, sampled and the fossils kept in a suitable institution.

Although no vertebrate fossils have been recorded from the Vryheid Formation, invertebrate trace fossils have been described in some detail by Mason and Christie (1986). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which is the earliest known reptile from the Karoo Basin, as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that Mesosaurus could be found in the Vryheid Formation.

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation of Natal. The Karoo sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine. In KwaZulu-Natal a shallow basin margin accommodated a prograding fluviodeltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1986).

- **Dolerite**

Due to the igneous nature of dolerite, no fossils will be found in the rock units.

The very high fossiliferous potential of the Vryheid Formation, Ecca Group strata, warranted an allocation of a Very High palaeontological sensitivity in the report to the areas underlain by the rocks of the Vryheid Formation. The Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity. The report also stated that if underground mining is planned, all the areas of mining will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils. The palaeontological report made the following recommendations:

- The EAP as well as the ECO for this project must be made aware of the fact that the Ecca Group sediments contains significant fossil remains, albeit mostly trace fossil and plant fossil assemblages. Several types of fossils have been recorded from this Group in the Karoo Basin of South Africa, with special mention of the Vryheid Formation.
- In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is envisaged (following the geotechnical investigation), or where fossils are recorded during the geotechnical investigations, a qualified palaeontologist must be appointed to assess and record fossils at specific footprints of infrastructure developments (Phase 1 PIA).
- These recommendations should form part of the EMP of the project.

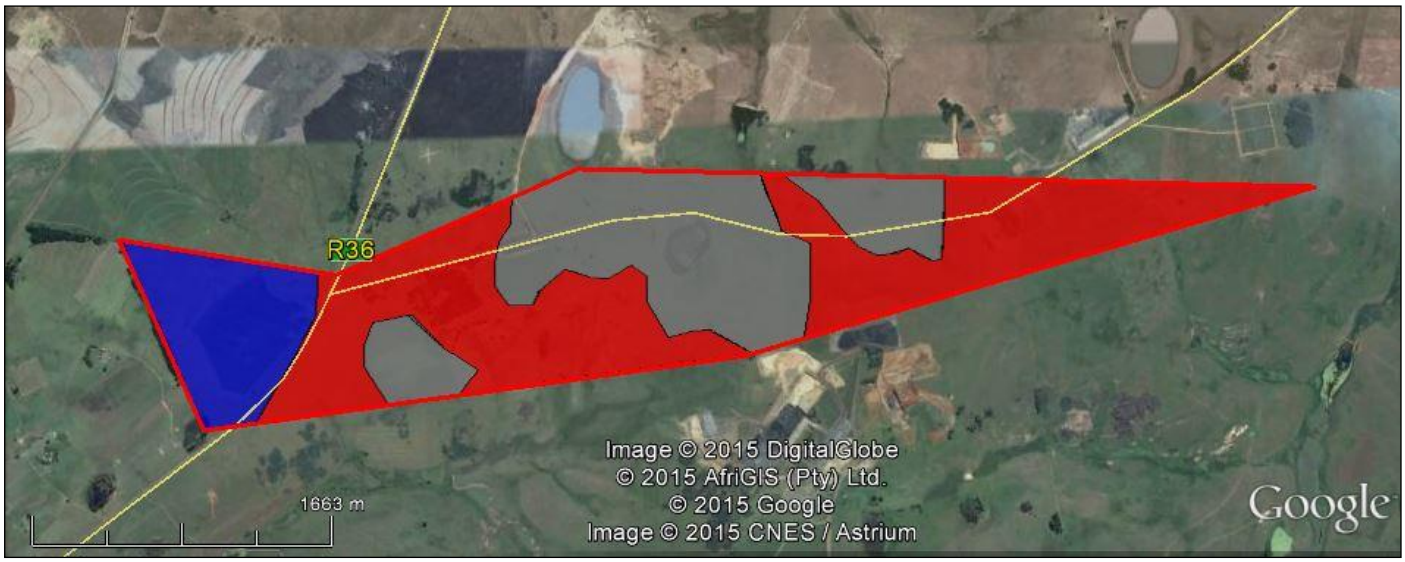

Figure 12 – The palaeontological sensitivity of the study area. Red represents those areas of the study area with a Very High Palaeontological Sensitivity, Blue those areas with a Low Palaeontological Sensitivity and Grey those areas with No Palaeontological Sensitivity (Groenewald, 2015).

7. BASELINE RECEIVING ENVIRONMENT

The study area's northern and central sections are topographical level whereas it slopes down towards the south.

The undisturbed sections of the study area can be described as primarily open grassland interposed by pockets of black wattle trees. A circular pan is located near the center of the farm.

Agricultural fields are located near the center and on the western ends of the farm with the remainder used for grazing purposes. The original farmstead and associated buildings and features are located in the western half of the property, with farm roads providing access to almost all segments of the farm.

A provincial gravel road cuts across the northern end of the farm with a provincial tar road (R36) splits the western end of the farm from the remainder of the property.

Figure 13 – General view of the study area.

Figure 14 (above)

General view of a section of the study area as well as existing mining development on a section of a neighbouring property. 14

Figure 15 (left)

Another general view of the study area.

8. SITE SENSITIVITIES

8.1 Introduction

The site sensitivities are derived from both the desktop study and fieldwork phases of the study.

8.2 Heritage Sites identified within the Study Area

During the Heritage Impact Assessment a pedestrian and vehicular survey of the study area was undertaken. As no surface impacts were envisaged, the fieldwork was aimed at those sections of the study area with the highest potential to contain archaeological and heritage sites. This said, the survey accessed all areas of the farm. The walkthrough was conducted on Wednesday, 29 April 2015 and Thursday, 30 April 2015 by a fieldwork team comprising two archaeologists (Polke Birkholtz and Jessica Angel). The fieldwork team was equipped with a hand-held GPS, and an overlay was created of their recorded track logs and the study area.

The Google Earth image below depicts the study area boundary with the track logs recorded by hand-held GPS during the fieldwork shown in white. Seven heritage sites were identified during the fieldwork. They are summarised in the table below, after which a detailed description of each heritage site is provided.

Figure 16 – Google Earth image depicting the study area boundaries in red with the recorded tracks logs in white

The map depicted below provides a distribution of the seven heritage sites identified within the study area. The congregation of all seven identified heritage sites in a relatively small section of the farm suggests that the sites were associated with one another. Even more so if one excludes the location of Site 1,with the remaining six identified heritage sites located within approximately 400 m from each other. It is therefore evident that the dipping structure at Site 1, the historic cemetery at Site 2 and the possible grave at Site 3 are all associated with the farmstead and its associated structures and buildings numbered for the purpose of this report as Sites 4 to 7.

Table 3- List of identified heritage sites with coordinates and a short description for each.

SITE NUMBER	COORDINATES	DESCRIPTION
SITE 1	S 26° 02’ 06.7” E 30° 09’ 48.5”	Dipping Structure
SITE 2	S 26° 02’ 06.0” E 30° 09’ 12.2”	Cemetery of the Davel Family
SITE 3	S 26° 02’ 07.2” E 30° 09’ 06.4”	Possible Grave
SITE 4	S 26° 02’ 13.9” E 30° 09’ 12.8”	Farm dwelling
SITE 5	S 26° 02’ 13.4” E 30° 09’ 13.5”	Rondavel
SITE 6	S 26° 02’ 12.8” E 30° 09’ 13.4”	Garage
SITE 7	S 26° 02’ 13.6” E 30° 09’ 10.1”	Shed

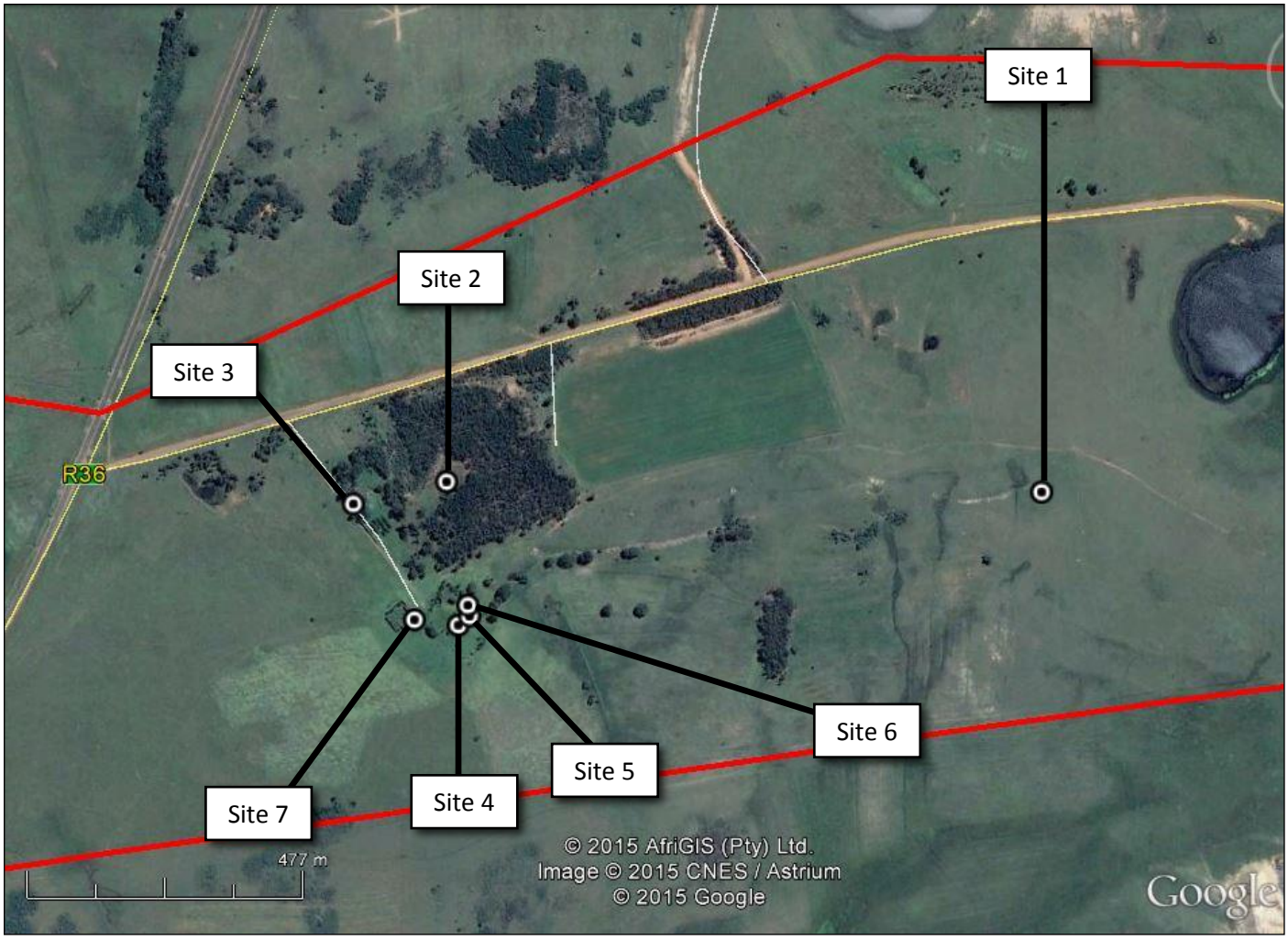

Figure 17 – Google Earth image depicting the distribution of identified sites. The red line represents the study area boundary whereas the positions of the seven identified sites are indicates. No heritage sites were identified during the site visit in those areas of the overall study area not depicted on this image.

8.2.1 SITE 1

Site Coordinates:

S 26° 02’ 06.7”
E 30° 09’ 48.5”

Site Description:

The site consists of an old farm dipping structure that is located roughly 1 km from the farmhouse (Site 4). The well executed stone masonry exhibited on the walls of the structure suggests that it is reasonably old. This premise is supported by the fact that the site is overgrown by woody vegetation. The site is located roughly 80 m south-west of the estimated position of the old wagon track which connected the farm with Carolina.

The archival research undertaken for this study has revealed that the site would have been located on the western portion of the farm Zandvoort. This western portion was only owned by individuals who would have built and used a dipping structure such as the one found here before 4 August 1879 (with individuals such as Gerhardus Theodorus Becking, James Martin Williams and Frans Coenraad Dekker owning the farm at the time) and after 6 March 1911 (when Johannes Gerhardus Albertus Davel acquired the farm). In between these two dates the farm portion was owned by the Cape Commercial Bank, businessman Hermann Ludwig Eckstein and the Transvaal Consolidated Land & Exploration Company Limited. With this as background and based on the characteristics of the structure and the way in which it was built, it is clear that the dipping structure was built after 6 March 1911. It is therefore certainly older than 60 years.

Site size: Approximately 15m x 15m.

Current Protection Status:

Structures older than 60 years fall under the protection of Section 34(1) of the National Heritage Resources Act 25 of 1999.

Site Significance:

While the site has some historical, architectural, technological and scientific value, it has very little aesthetic, social, spiritual or linguistic value. As a result the site has a **GP. B - Medium Significance**.

Figure 18 –General view of a section of the dipping structure. The vegetation already well established within the structure provides some indication of its age.

Figure 19–Side wall of the dipping structure. Note how well it is built.

8.2.2 SITE 2

Site Coordinates:

S 26° 02’ 06.0”
E 30° 09’ 12.2”

Site Description:

This site consists of a formal white cemetery of the Davel family and is located roughly 240 m north of the farm dwelling at Site 4. Three marked graves were identified in a single row with a possible fourth grave indicated by a low soil heap. The cemetery is enclosed by a rectangular stone wall which has an access gate on its southern end. The cemetery does not appear to have been visited recently as it is not well maintained.

All the graves are orientated along the east-west axis and the three marked ones have granite headstones on their western ends with rectangular granite lined dressings. The details depicted on these inscribed headstones are provided below.

TER GEDAGTENIS AAN ONS GELIEFDE SEUN EN BROER WYNAND J. DAVEL GEB: 27 APR. 1916 OORL: 25 FEB. 1941 PS: 34 - 2	TER NAGEDAGTENIS AAN ONS GELIEFDE EGGENOOT EN VADER J.G.A. DAVEL GEB. 16 AUG. 1865 OVERLEDEN 1 FEB. 1923 PS. 23. DE HEER IS MYN HERDER.	IN LIEFDEVOLLE HERINNERING AAN ONS DIERBARE MOEDER HESTER MARIA GEB. (VAN NIEKERK) 8-11-1870. OORL. 28-8-1945. KOM NA MY ALMAL EK SAL JULLE RUS GEE DAVEL

It is evident from the names appearing on these three marked graves that they belonged to the Davel family. During the archival research undertaken for the present study it was found that a Johannes Gerhardus Albertus Davel (16 August 1865 – 1 February 1923) acquired the farm Zandvoort on 6 March 1911. It is evident that the J.G.A. Davel on the headstone of the oldest grave from this cemetery is one and the same as Johannes Gerhardus Albertus Davel. He owned the farm until his death on 1 February 1923. In terms of his estate the farm was subdivided between two of his sons namely Tobias Davel (who acquired the eastern portion) and Wynand J. Davel (who acquired the western portion). Wynand J. Davel, who is the second person buried at this cemetery, passed away at the young age of 24. His western portion of the farm was subsequently subdivided and transferred to his mother Hester Maria Davel (born Van Niekerk) and three other siblings. Ms. Davel remained on this portion of the farm until her death on 28 August 1945. She was buried in the same cemetery with her husband and son.

Site size: 15 m x 5 m

Current Protection Status:

Graves and burial grounds fall under various legislative protections, depending on factors such as where the graves are located as well as their age. Such legislation may include the National Heritage Resources Act 25 of 1999, the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), the Human Tissue Act 65 of 1983, the Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws that may be in place.

Site Significance:

Graves and burial grounds have high levels of emotional, religious and historical significance. As a result the site has a **GP. A - High Significance**.

Figure 20–The grave of Johannes Gerhardus Albertus Davel.

Figure 21–The grave of Hester Maria Davel (born Van Niekerk).

Figure 22–The grave of Wynand Jacobus Davel.

8.2.3 SITE 3

Site Coordinates:

S 26° 02’ 07.2”
E 30° 09’ 06.4”

Site Description:

An elongated stone concentration was observed near the entrance of what appears to have been farm worker accommodation. The structure is orientated along the north-west by south-east axis. A lower grinding stone was observed on the stone concentration.

Apart from the fact that the feature is a stone concentration with a lower grinder on it, not additional supportive information for the presence of a grave here could be found. For example, the stone concentration does not have a formal headstone and its position at the entrance to the farm worker accommodation suggests that it may have been part of a garden feature.

For the purposes of this report a worst case scenario will be used within which it is assumed that a grave is located here. This scenario can only be refuted by either conclusive social consultation findings or excavations.

Current Protection Status:

Graves and burial grounds fall under various legislative protections, depending on factors such as where the graves are located as well as their age. Such legislation may include the National Heritage Resources Act 25 of 1999, the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), the Human Tissue Act 65 of 1983, the Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws that may be in place.

Site Significance:

Graves and burial grounds have high levels of emotional, religious and historical significance. As a result the site has a **GP. A - High Significance**.

Figure 23–General view of the possible grave as seen from the main farm access road.

Figure 24–Closer view of the possible grave.

8.2.4 SITE 4

Site Coordinates:

S 26° 02’ 13.9”
E 30° 09’ 12.8”

Site Description:

A historic farm dwelling is located here. It was erected on a solid sandstone foundation that was built in such a way that a terraced appearance against the slight slope of the site was created. As a result the foundation on the lower end of the slope (the building’s southern facade) is roughly 0.5 m high whereas the sandstone foundation on the higher side of the building (the northern facade) is nearly invisible. While sections of the walls were certainly built of brick, other presently plastered and painted sections may have been of sandstone as well. This is however not certain.

The dwelling has a ventilated hipped roof of corrugated iron which allowed for the placement of two triangular wooden ventilator louvers directly under the roof’s ridge on both the eastern end western ends of the building. These louvers provided ventilation through the roof and possible attic space and allowed for a better ventilated building (Mauritz Naudé, pers. comm.).

The front and back facades of the dwelling are characterised by the presence of a verandas on those ends. According to architectural historian Mauritz Naudé this is a characteristic of “...*most farm houses...”* in South Africa (Naudé, 2010:26). In the case of the dwelling under discussion, its northern veranda is still relatively intact whereas the northern facade has been changed to such an extent that just the veranda pillars can still be seen.

The eastern end of the dwelling is characterised by a rectangular pitched roof section which flanks the entire width of the building including the two verandas. While it is possible that this building represents the result of connecting two stoepkamers with one another, it may also be possible that it represents an original component to the house. The northern and southern gabled sections would have had a fireplace as is indicated by the presence of a chimney on each end. Furthermore, the front (northern) gable section contains the remains of a wooden gable decoration as well as a circular attic ventilator.

It is evident that the dwelling was significantly altered over the years. These alterations are especially evident on the northern, eastern and western facades of the building. As indicated before, the veranda on the northern facade (including its roof section) was removed whereas modifications were made to the eastern and western ends.

In establishing the age of a historic building various sources of information can be used successfully, including the dating of a building based on its architectural styles and architectural detailing used as well as an assessment of historical and archival maps and references.

In terms of architectural style and detailing, for example, the wooden gable decoration still evident on the dwelling was very popular during the South African War (1899 – 1902) when the British Army shipped large numbers of corrugated iron cantonments in crates from England for easy erection across Southern Africa. Such gable decoration may as a result have been acquired from a disused British cantonment in the Carolina District and placed on the building. It is also important to note that the wooden gable decoration was popular during the Edwardian Period (1900 – 1915) when the metal decoration of the Victorian Period was increasingly replaced with wooden features. This means that the wooden decoration on this building may date to the period between roughly 1900 and 1910 (Mauritz Naudé, pers. comm.).

The design of the two chimneys was popular during the period from 1880 to 1902, but in some cases can be found in the period after the war as well ((Mauritz Naudé, pers. comm.).

From the above-mentioned architectural information it is clear that the building can most likely be dated to the Edwardian Period between 1900 and c. 1910. The archival and historical maps and diagrams assessed as part of this study have shown that the farm dwelling is not depicted on a survey diagram that was compiled in 1896 and seemingly also not on a map from c. 1913. However, it is worth noting that it is not exactly certain when this latter map was surveyed in the field. While the map was likely printed in 1913, the surveys may very well have been undertaken a few years prior. From this information it would appear that the dates suggested by the architectural style and details may hold true.

With this as background, one can identify the person responsible for the construction of the building from the farm ownership history obtained during the archival research. As indicated elsewhere, the portion of the farm where this dwelling is located would over the years have been owned by a number of different individuals and companies. This ownership history commenced with Gerhardus Theodorus Becking (3 August 1869), James Martin Williams (10 January 1876), Frans Coenraad Dekker (7 February 1876), the Cape Commercial Bank (4 August 1879), Hermann Ludwig Eckstein (7 December 1880), the Transvaal Consolidated Land & Exploration Company Limited (11 June 1892) and Johannes Gerhardus Albertus Davel (6 March 1911). The latter person owned the farm until his death in 1926.

A number of these previous owners can immediately be excluded from the list of possible builders of the farm dwelling. These include James Martin Williams who owned the farm for less than a month, companies such as the Cape Commercial Bank and the Transvaal Consolidated Land & Exploration Company Limited as well as the businessmen Hermann Ludwig Eckstein. The only remaining potential builders of the house would be Gerhardus Theodorus Becking,

Frans Coenraad Dekker and Johannes Gerhardus Albertus Davel. Becking and Dekker can also be excluded from the list as any building erected by them would have appeared on the 1896 diagram and would not have been built in an Edwardian style which is dated from 1900 to 1915. From this it seems highly likely for the building to have been erected by Johannes Gerdhardus Albertus Davel shortly after his acquisition of the farm on 6 March 1911.

It is evident that the building is older than 100 years and can be classified as an archaeological site.

Site size: 30 m x 20 m.

Current Protection Status:

In terms of Section 35(4) of the National Heritage Resources Act (25 of 1999) man-made features and artefacts older than 100 years are defined as being archaeological. In the same section the act also states that such archaeological sites and objects may not be disturbed, altered, modified or destroyed without a suitable permit from the South African Heritage Resources Agency (SAHRA).

Site Significance:

The site possesses high levels of historic, architectural and emotional significance. The building has however been significantly altered and modified over time. As a result the site has a **GP. B – Medium Significance**.

Figure 25–Various views of the farm dwelling at Site 4. The top image depicts the northern facade with the middle image the southern facade. The two images at the bottom depict the eastern facade and a gabled wing.

8.2.5 SITE 5

Site Coordinates:

S 26° 02’ 13.4”

E 30° 09’ 13.5”

Site Description:

A rondavel is located a short distance to the east of the farm dwelling. Its walls are of dressed sandstone and the building has a wooden door facing the dwelling. The only other openings in the structure are two small rectangular windows. The doorframe, window frames and lintels above the openings are all of wood. The building would originally have had a thatched roof, but is presently covered by corrugated iron sheets.

The building is a typical outbuilding and would in all likelihood have been used either as a milk room or meat room. Its position so close to the dwelling would have facilitated such an extension to the food preparation activities of the farmstead.

It can be expected that the rondavel was built at roughly the same time as the farm dwelling.

Site size: Approximately 4m in diameter.

Current Protection Status:

Structures older than 60 years fall under the protection of Section 34(1) of the National Heritage Resources Act 25 of 1999. In terms of Section 35(4) of the National Heritage Resources Act (25 of 1999) man-made features and artefacts older than 100 years are defined as being archaeological. In the same section the act also states that such archaeological sites and objects may not be disturbed, altered, modified or destroyed without a suitable permit from the South African Heritage Resources Agency (SAHRA).

Site Significance:

The site possesses high levels of historic and architectural significance and represents a reasonably common feature of the vernacular Highveld farms architecture. The site has a **GP. B – Medium Significance**.

Figure 26–General view of the rondavel structure. Note the lintel, door and doorframe all manufactured of wood.

Figure 27–Another view of the rondavel structure. Note the small rectangular window with wooden frame and lintel.

8.2.6 SITE 6

Site Coordinates:

S 26° 02’ 12.8”
E 30° 09’ 13.4”

Site Description:

A double garage is located here which is partially built of dressed sandstone and partially of bricks. It would appear that the dressed sandstone components of this structure would have been directly associated with the original farmstead and is quite likely as old as the farm dwelling. At the time the structure may have been used as a wagon shed or possibly as a general purpose farm shed. In later years the building would have been re-purposed as a double garage and workshop.

Site size: Approximately 15 m x 10 m.

Current Protection Status:

Structures older than 60 years fall under the protection of Section 34(1) of the National Heritage Resources Act 25 of 1999. In terms of Section 35(4) of the National Heritage Resources Act (25 of 1999) man-made features and artefacts older than 100 years are defined as being archaeological. In the same section the act also states that such archaeological sites and objects may not be disturbed, altered, modified or destroyed without a permit from SAHRA.

Site Significance:

The site possesses high levels of historic and significance. The site has a **GP. B – Medium Significance**

Figure 28–General view of the structure.

8.2.7 SITE 7

Site Coordinates:

S 26° 02’ 13.6”
E 30° 09’ 10.1”

Site Description:

An “L” shaped shed is located roughly 60 m from the farm dwelling. Significant sections of the shed contain dressed sandstone walls with smaller components built of brick. The south-eastern corner of the building appears to have been its original core and has well built dressed sandstone walls with sandstone lintels above the window and door openings. Other sections of the overall building also have sandstone walls, but these appear more rudimentary and would in all likelihood have been erected at the same time that the brick sections were built.

The original core would have been used as a milking shed, and this function appears to have been carried through into later years.

This original milking shed would have been built at the same time as the farm dwelling.

Site size: Approximately 34 m x 34 m x 10 m

Current Protection Status:

Structures older than 60 years fall under the protection of Section 34(1) of the National Heritage Resources Act 25 of 1999. In terms of Section 35(4) of the National Heritage Resources Act (25 of 1999) man-made features and artefacts older than 100 years are defined as being archaeological. In the same section the act also states that such archaeological sites and objects may not be disturbed, altered, modified or destroyed without a suitable permit from the South African Heritage Resources Agency (SAHRA).

Site Significance:

The site possesses high levels of historic and architectural significance and has a **GP. B – Medium Significance**

Figure 29–The south-eastern corner of the building representing what appears to be the oldest component of the site. Sandstone lintels above the window and door openings can be seen on the right.

Figure 30–Different phases in the construction and use of the building can be seen from this image. The brick sections on the left would have represented a second or potentially third building phase with the sandstone component on the right potentially younger than the sandstone section on the south-eastern end of the site.

8.3 Heritage Sensitivities identified during Desktop Studies

8.3.1 Palaeontological Sensitivity

As indicated above, a palaeontological desktop study was undertaken of the farm Zandvoort 10 IT by Dr. Gideon Groenewald. Refer Annexure C for a copy of the report.

The desktop study found that the study area is mainly underlain by Permian aged rocks of the Dwyka Group and Vryheid Formation, Ecca Group, Karoo Supergroup and Jurassic aged dolerite sills.

The very high fossiliferous potential of the Vryheid Formation, Ecca Group strata, warranted an allocation of a Very High palaeontological sensitivity in the report to the areas underlain by the rocks of the Vryheid Formation. The Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity. The report also stated that if underground mining is planned, all the areas of mining will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils. The palaeontological report made the following recommendations:

- The EAP as well as the ECO for this project must be made aware of the fact that the Ecca Group sediments contains significant fossil remains, albeit mostly trace fossil and plant fossil assemblages. Several types of fossils have been recorded from this Group in the Karoo Basin of South Africa, with special mention of the Vryheid Formation.
- In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is envisaged (following the geotechnical investigation), or where fossils are recorded during the geotechnical investigations, a qualified palaeontologist must be appointed to assess and record fossils at specific footprints of infrastructure developments (Phase 1 PIA).
- These recommendations should form part of the EMP of the project.

9. SITE CONSTRAINTS

From the site sensitivities above it is evident that a number of site constraints can be identified. These are as follows:

- Palaeontology

  While those sections of the study area underlain by the Vryheid Formation is allocated a Very High palaeontological sensitivity, the sections underlain by the Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity.

The report also stated that if underground mining is planned (as is the case here), all mining areas from within the study area will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils.

- Heritage Sites

Seven heritage sites were identified within the study area during the fieldwork, including an old dipping structure (Site 1), a historical white cemetery (Site 2), possible grave (Site 3), farmhouse (Site 4), rondavel (Site 5), garage (Site 6) and old shed (Site 7).

The proposed mining development at Zandvoort 10 IT will be conducted underground. There are unlikely to be any surface impacts if mining is undertaken correctly and safely because of the safety factors required. However potential impacts include vibration and surface subsidence, although these are highly unlikely to occur. The impact of such highly unlikely surface impacts as a result of underground mining on the identified heritage sites will form part of the assessment below.

10. IMPACT ASSESSMENT

10.1 Introduction

Two development alternatives were assessed in this heritage impact assessment, namely:

- **Alternative 1: No Go Alternative**

This alternative will imply that no development takes place at Zandvoort 10 IT and that the environment remains unchanged and unaltered. ***For this alternative the assumption is that no heritage resources will be impacted on. As a result no further evaluation of impacts will be done for this alternative.***

- **Alternative 2: Proposed Underground Mining at Zandvoort 10 IT**

This alternative entails a mine plan which comprises the underground mining of coal at Zandvoort IT. In this alternative the proposed development consists of underground activities only.

10.2 Impact Assessment in terms of Alternative 2 Proposed Underground Mining at Zandvoort 10 IT

The following two site sensitivities in terms of the development activity associated with this alternative can be identified, namely the impact on palaeontology as well as the possible (yet highly unlikely) impact on the identified heritage sites.

10.2.1 Palaeontological Sensitivity

10.2.1.1 Discussion

As indicated above, a palaeontological desktop study was undertaken of the farm Zandvoort 10 IT by Dr. Gideon Groenewald. Refer Annexure C for a copy of the report. The desktop study found that the study area is mainly underlain by Permian aged rocks of the Dwyka Group and Vryheid Formation, Ecca Group, Karoo Supergroup and Jurassic aged dolerite sills.

The very high fossiliferous potential of the Vryheid Formation, Ecca Group strata, warranted an allocation of a Very High palaeontological sensitivity in the report to the areas underlain by the rocks of the Vryheid Formation. The Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity. The report also stated that if underground mining is planned, all the areas of mining will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils.

The fossil coal floras of South Africa are of international interest and represent an important part of our local heritage. Any loss of this heritage due to mining or construction is permanent, and should be regarded as a highly significant negative impact. However, the discovery of fossils during mining followed by effective mitigation in collaboration with a palaeontologist, would result in the curation of new and important fossil material. As a result the development could potentially have a positive, beneficial impact on South Africa's palaeontological heritage.

10.2.1.2 Assessment

Any destruction of fossils is a permanent negative impact and must be regarded as potentially a high impact significance. New taxa are fairly regularly encountered in plant fossil studies, and destruction of well-preserved, undescribed fossil beds could represent a serious loss in terms of our understanding of historical biodiversity.

This assessment holds true during both the construction and operational phases of this alternative.

Refer to Table 5 for the impact evaluation on palaeontological resources in terms of Alternative 2.

Table 3– Impact table: Damage/Destruction of Palaeontological Resources – Underground Coal Mining - Construction and Operational Phases

Impact Name:	*Impact on Palaeontological Resources*		
Phase:	*Construction and Operational Phase*		
Alternative:	*Alternative 2: Underground Coal Mining*		
Description of Impact:	*During the construction and operational phases of the mining project, impacts can occur to the palaeontological resources prevalent in the Vryheid Formation.*		
Environmental Risk			
Attribute	**Pre-mitigation**	**Post-mitigation**	
Nature of Impact	-1	-1	
Extent of Impact	3	3	
Duration of Impact	5	5	
Magnitude of Impact	4	2	
Reversibility of Impact	5	3	
Probability	4	3	
Environmental Risk (Pre-mitigation)			**-17**
Environmental Risk (Post-mitigation)			**-9.75**
Degree of confidence in impact prediction:			Medium
Recommended Mitigation Measures			
• *The EAP as well as the ECO for this project must be made aware of the fact that the Ecca Group sediments contains significant fossil remains, albeit mostly trace fossil and plant fossil assemblages. Several types of fossils have been recorded from this Group in the Karoo Basin of South Africa, with special mention of the Vryheid Formation.* • *In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is envisaged (following the geotechnical investigation), or where fossils are recorded during the geotechnical investigations, a qualified palaeontologist must be appointed to assess and record fossils at specific footprints of infrastructure developments (Phase 1 PIA).* • *These recommendations should form part of the EMP of the project.*			
Impact Prioritisation			
Public Response			1
The public response is not known, but expected to be low.			
Cumulative Impacts			2
The potential to impact negatively on plant fossils will remain as long as mining continues to expose and destroy fossiliferous strata. The mining of coal is by definition the mining of fossil plant material, but it is accepted that the significant fossils in terms of palaeontological heritage, will be associated with country rock and spoil material.			
Degree of potential irreplaceable loss of resources			3
In palaeontological terms any destruction of fossils is a permanent negative impact and must be regarded as potentially high impact significance. New taxa are fairly regularly encountered in plant fossil studies, and destruction of well-preserved, undescribed fossil beds could represent a heavy loss in terms of our understanding of historical biodiversity.			
Prioritisation Factor			1.5
FINAL SIGNIFICANCE			**-14.63**

10.2.2 Impact on Identified Heritage Sites

10.2.2.1 Discussion

All seven identified heritage sites are surface occurrences and as a result the proposed underground mining activities at Zandvoort 10 IT are not expected to have any direct negative impact on any of these seven heritage sites. Such surface impacts are unlikely if mining is undertaken correctly and safely because of the safety factors required. However potential impacts include vibration and surface subsidence, although these are highly unlikely to occur.

In the instance that such highly unlikely surface impacts do occur, the identified heritage sites which would potentially be at highest risk would be the white cemetery (with its large upright headstones) (see Site 2) and the farm dwelling (Site 4).

The impact of such highly unlikely surface impacts as a result of underground mining on the identified heritage sites will form part of the assessment below.

10.2.2.2 Assessment

Any disturbance to graves (Sites 2 and 3) and historical structures and buildings (Sites 1, 4, 5, 6 and 7) represents a negative impact and must be regarded as potentially a high impact significance. The legal, ethical and financial implications of the disturbance to graves and grave dressings could be severe.

As indicated above, in the highly unlikely event that surface impacts as a result of underground mining do occur, the white cemetery at Site 2 and the farm dwelling at Site 4 would in all likelihood be most at risk. This is simply due to the high upright headstones at Site 2 as well as the age and characteristics of the dwelling at Site 4.

This assessment holds true during both the construction and operational phases of this alternative.

Refer to Table 6 for the impact evaluation on the potential, yet highly unlikely, surface impact resulting from the underground mining activities in terms of this Alternative.

Table 4– Impact table: Damage to Identified Heritage Sites – Underground Coal Mining - Construction and Operational Phases

Impact Name:	*Impact on Identified Heritage Sites*		
Phase:	*Construction and Operational Phase*		
Alternative:	*Alternative 2: Underground Coal Mining*		
Description of Impact:	*During the construction and operational phases of the mining project, highly unlikely impacts can occur to identified heritage sites on the surface of the study area due to vibration and surface subsidence.*		
Environmental Risk			
Attribute	**Pre-mitigation**	**Post-mitigation**	
Nature of Impact	-1	-1	
Extent of Impact	2	2	
Duration of Impact	3	3	
Magnitude of Impact	3	2	
Reversibility of Impact	4	3	
Probability	2	1	
Environmental Risk (Pre-mitigation)			**-6.00**
Environmental Risk (Post-mitigation)			**-2.00**
Degree of confidence in impact prediction:			Medium
Recommended Mitigation Measures			
• *A relatively low frequency archaeological monitoring programme must be implemented to identify any potential impacts on the identified heritage sites as a result of highly unlikely events of vibration or surface subsidence.*			
Impact Prioritisation			
Public Response			1
The public response is not known, but a relatively low level response is expected.			
Cumulative Impacts			2
Medium level cumulative impacts are expected.			
Degree of potential irreplaceable loss of resources			2
Any disturbance to graves or heritage sites destruction represents a negative impact. However, such impacts would not be irreversible in view of the fact that only low-level disturbance is expected in terms of a highly unlikely worst-case scenario. Even if such highly unlikely impacts do occur, these would not represent the total destruction of the identified heritage sites but rather only relatively small-scale disturbance such as for example the cracking of a building wall etc.			
Prioritisation Factor			1.33
FINAL SIGNIFICANCE			**-2.67**

11. MITIGATION MEASURES SUGGESTED

11.1 Introduction

In this section the mitigation measures to be followed to minimize the impact of the proposed development on heritage will be outlined and discussed.

11.2 Suggested Measures to Mitigate the impact of the Proposed Development on Palaeontology

11.2.1 General Recommendations

The following recommendations are made in the palaeontological desktop study undertaken by Dr. Gideon Groenewald:

- The EAP as well as the ECO for this project must be made aware of the fact that the Ecca Group sediments contains significant fossil remains, albeit mostly trace fossil and plant fossil assemblages. Several types of fossils have been recorded from this Group in the Karoo Basin of South Africa, with special mention of the Vryheid Formation.
- In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is envisaged (following the geotechnical investigation), or where fossils are recorded during the geotechnical investigations, a qualified palaeontologist must be appointed to assess and record fossils at specific footprints of infrastructure developments (Phase 1 PIA).
- These recommendations should form part of the EMP of the project.

In the section that follows the proposed methodology for mitigating the impact on palaeontology that was compiled by Dr. Gideon Groenewald will be provided.

11.2.2 Proposed Methodology for Recovering Fossils

The following principals apply in terms of the mitigation of the palaeontology:

- The sedimentary rocks (shale and sandstone) of the Vryheid Formation contain important fossils and mitigation for the chance find of these fossils should form part of the EMP of the mine.
- The coal beds themselves contain fossil plant remains, but these are normally studied as part of the initial assessment of the quality of the coal and enough information will be available to study these fossils without sampling during the mining operations.
- The fossil remains that are of greater interest for Palaeontological Heritage are associated with the “country rock” or shale beds that are normally removed as spoil material during mining.

- Without some mitigation measures, the loss of fossils during mining operations will have a highly negative impact on palaeontological heritage, whereas proper mitigation and collection of fossils during the mining operation will have a significant positive impact on palaeontological heritage.

It is unlikely that fossils will be observed during active mining operations, mainly due to the fact that the rocks will be covered in dust and fossils will only be visible after exposure to the elements for a certain period of time. The practical way of finding fossils will be to inspect the exposed shale beds and other shale scree that is produced by the mining operation and is therefore part of the spoil dump material and not part of the underground ore body.

11.2.3 Mitigation of Mining Impact on Palaeontological Resources

11.2.3.1 Mitigation Measures Required

- A palaeontologist must conduct a single one-day site visit to the present mining operation on the property located adjacent to Zandvoort as soon as possible to inspect the presence of possible fossil material in the spoil heaps of the existing mine. This site visit would be aimed at assessing the potential for significant fossils to be impacted upon by the proposed underground mining activities on the Zandvoort property.
- Two possible outcomes may result from the site visit, namely: (a) the palaeontologist finds that there is no potential for significant fossil material to be impacted upon by the proposed underground mining activities. Subsequently, the palaeontologist will provide a write up of his/her findings indicating that no further work would be required. This write-up will be submitted to SAHRA. (b) The palaeontologist establishes that the potential for significant fossil material to be impacted upon by the proposed mining property does exist. The palaeontologist must then provide a write up of his/her findings and submit this to SAHRA. The appointed palaeontologist, in consultation with the mining company, must then develop a long-term strategy and budget for the recovery of significant fossils during the mining operation. This strategy may include site visits to monitor the spoil heaps, the collection of representative samples as well as the curation of fossil material.

11.2.3.2 Functional Responsibilities of Appointed Palaeontologist

- Conduct a single on-site visit to the existing mining operation located adjacent to the Zandvoort property to assess the palaeontological potential of the area and more specifically whether the proposed underground mining activities at Zandvoort is expected to impact any significant fossils.
- Provide a write-up of the conclusions of the site visit to the client and SAHRA.
- If the site visit indicates that significant fossils may very well be located at Zandvoort, the palaeontologist, in conjunction with the mine management, must develop a long-term strategy and budget for the recovery of significant fossils during the mining operation.

11.3 Suggested Measures to Mitigate the impact of the Proposed Development identified Heritage Sites

11.3.1 General Recommendations

As mentioned above the highly unlikely possibility exists for surface impacts to take place as a result of the proposed underground mining at Zandvoort 10 IT. The following general recommendations can be made to mitigate this impact:

- A suitably qualified archaeologist must establish a suitable number of fixed points for each identified heritage sites and photographically record the seven heritage sites from these pre-defined fixed points. This photographic record will then be used as the starting baseline record of the identified heritage sites and will be used during the monitoring process to identify any disturbance or damage as a result of the underground mining activity. The ECO must accompany the archaeologist on this recording to familiarise him/her with the monitoring methodology and the fixed photographic points that will be used in the process of monitoring.
- A low intensity monitoring program must be implemented whereby all seven identified heritage sites must be visited on a pre-defined schedule by the project ECO to ascertain whether any visible impacts as a result of underground mining can be identified. During visits to each of the sites the same fixed-point photographs must be taken and general observations.
- The monitoring of Site 3 and Site 4 must be undertaken once every three months, with the monitoring of the remaining five sites (Site 1 & 2 as well as Sites 5 – 7) conducted once every six months. The higher frequency of monitoring visits to Site 3 and Site 4 is due to their structure and characteristics that would be more susceptible to disturbance or damage from underground activities.
- At the conclusion of each monitoring visit the ECO must compile a brief monitoring report depicting all the fixed-point photographs and general observations about each site that was visited during the previous monitoring visit (i.e. either all the sites or only Sites 3 & 4 depending on the time of the monitoring schedule). The report must also provide the findings of the ECO as to whether any impacts or disturbance could be identified at any of the sites.
- Each monitoring report must be sent electronically through to the EAP, mine manager and archaeologist. The archaeologist's responsibilities would be to purview each report and assess its conclusions.

11.3.2 Mitigation of Mining Impact on Identified Heritage Sites

11.3.2.1 Mitigation Measures Required

The following general mitigation measures must be undertaken:

- The mitigation of the highly unlikely surface impact of the proposed underground mining activities on the seven identified heritage sites will be undertaken by means of a low intensity monitoring program by an ECO with assistance provided by the archaeologist.

Two possible outcomes for this mitigation exist, namely that no evidence for impact is found and secondly that evidence for surface impacts are found. In the first instance the same frequency of monitoring visits must simply be continued with. However, if evidence of surface impacts to any of the identified heritage sites are found, the following measures would apply:

- The evidence of surface impacts must be reported in the monitoring report writing to the EAP, Mine Manager and archaeologist.
- Depending on the heritage site where surface impacts had been identified, suitable mitigation measures must be recommended by the professional archaeologist, which may range from the recording of the historical farm dwelling by an architectural historian coupled with a disturbance permit from SAHRA to the restoration of damaged headstones.

11.2.3.2 Functional Responsibilities of the Mining Company

- Appoint at their cost a professional archaeologist to undertake the monitoring.
- Make provision for the ECO to be responsible for the monitoring visits and monitoring reports.
- Should evidence for disturbance to the identified heritage sites be found, the mining company must implement the recommendations made by the appointed archaeologist to mitigate such impacts.

11.2.3.3 Functional Responsibilities of the Responsible Archaeologist

- To define a suitable number of fixed points around each of the seven identified heritage sites and to then photographically record each of the seven sites by using the pre-defined fixed points. During the time spent recording the seven sites the archaeologist must provide training to the ECO to familiarise him/her with the monitoring process and the use of fixed-point photography.
- To purview each monitoring report and ensure that he/she is happy with its contents and conclusions.
- Should any evidence for disturbance be identified in the report or on the photographs, the archaeologist must provide the mining company with guidance on the future steps to be followed in the mitigation of the identified surface impact.
- To ensure that the monitoring reports are received as scheduled, to ensure that the required photographs and information is represented in each monitoring report and also to confirm that he/she agrees with the conclusions drawn from each monitoring report.

11.4 Summary of Mitigation Measures

11.4.1 Mitigation Measures for Palaeontology

The first required mitigation measures are outlined in table form below. It is important to note that the measures outlined here comprise a site visit and palaeontological write-up. Based on the conclusions of the palaeontologist following on the site visit, two possible outcomes exist. These are as follows: (a) that no significant fossils are located in the area which means that no further work would be required and (b) that significant fossils are located in the area. In terms of the second outcome, further mitigation work would be required starting with the drafting of a strategy and budget by the palaeontologist, mine management and ECO within which the impact on palaeontology during mining activities can be mitigated.

11.4.2 Mitigation Measures for Identified Heritage Sites

The mitigation measures required in terms of the potential (though highly unlikely) surface impact on the identified heritage sites are outlined below. Please note that the information contained in the table below only outlined the required mitigation measures up to the point that evidence for surface impacts to the identified heritage sites as a result of underground mining is found. The exact mitigation measures to be followed after this point will be provided by the archaeologist who identified evidence for the surface impact and as indicated will depend on the conditions of the site and the characteristics of the discovery.

12. ACTION PLAN FOR IMPLEMENTATION

12.1 Basic Principles of the Action Plan

The action plan to mitigate identified development impacts is based on the following overriding principles:

- The minimisation of the disturbance of the proposed mining activities to the palaeontology of the area
- The minimisation of the disturbance of the proposed mining activities to identified heritage sites.

12.2 Management Measures and Mechanisms

The management measures and mechanisms to minimize the mining impact on palaeontology, are as follows:

- The palaeontologist must conduct a single one-day site visit to the present mining operation on the property located adjacent to Zandvoort as soon as possible to inspect the presence of possible fossil material in the

spoil heaps of the existing mine. This site visit would be aimed at assessing the potential for significant fossils to be impacted upon by the proposed underground mining activities on the Zandvoort property.

- Two possible outcomes may result from the site visit, namely: (a) the palaeontologist finds that there is no potential for significant fossil material to be impacted upon by the proposed underground mining activities. Subsequently, the palaeontologist will provide a write up of his/her findings indicating that no further work would be required. This write-up will be submitted to SAHRA. (b) The palaeontologist establishes that the potential for significant fossil material to be impacted upon by the proposed mining property does exist. The palaeontologist must then provide a write up of his/her findings and submit this to SAHRA. The appointed palaeontologist, in consultation with the mining company, must then develop a long-term strategy and budget for the recovery of significant fossils during the mining operation. This strategy may include site visits to monitor the spoil heaps, the collection of representative samples as well as the curation of fossil material.

The management measures and mechanisms to minimize the impact on identified heritage sites are as follows:

- A monitoring program must be implemented whereby the ECO conducts monitoring visits as per a pre-defined schedule to each of the identified heritage sites during the construction and operational phases of the project. Any identified evidence for surface impacts to the identified heritage sites can then be acted upon and suitably mitigated.

12.3 Required Actions

The individual actions required to implement the mitigation of the impact of the proposed mining development on palaeontology and potentially (though highly unlikely) on identified heritage sites, are outlined in **Table 12** below.

Table 5- Initial Mitigation Measures required for Palaeontology

No.	Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
1. Immediate Mitigation in terms of Palaeontology							
A	The Applicant together with the ECO shall identify a suitably qualified palaeontologist to assist in conducting the mitigation of the mining impact on the palaeontological resources of the study area. Once identified this individual or company must be appointed.	Planning	Immediate action that needs to be undertaken well in advance of construction	Applicant ECO	ECO (Monthly)	The appointed palaeontologist would direct the way in which the impact on palaeontology can be mitigated.	(ECO Monthly Checklist/Report)
2. Priority Mitigation Measures after appointment of Palaeontologist							
A	A single site visit must be undertaken by the appointed palaeontologist to the existing mining property located adjacent to Zandvoort. The aim of the site visit is to assess the potential for the significant fossils to be impacted upon by the proposed underground mining activities.	Planning	Priority action to follow on appointment of palaeontologist. Must be undertaken well in advance of construction	Appointed Palaeontologist ECO	ECO Applicant	To assess the potential for significant fossils to be impacted upon by the proposed underground mining activities at Zandvoort.	(ECO Monthly Checklist/Report)
B	The appointed palaeontologist must produce a write-up of his/her findings in terms of the site visit. The write-up must clearly state whether the area does or does not have the potential for significant fossils to be impacted upon by the proposed underground mining activities at Zandvoort. Once completed, the write-up must be submitted to the ECO, Mine Manager and SAHRA.	Planning	Priority action after completion of previous action. Must be undertaken well in advance of construction.	Appointed Palaeontologist ECO	ECO Applicant	To compile a write-up of the findings of the site visit and present such findings in writing to the ECO, Mine Manager and SAHRA.	(ECO Monthly Checklist/Report)

C	If the write-up by the palaeontologist has established that the underground mining activities at Zandvoort will in fact impact on significant fossils, the palaeontologist in conjunction with the mine management and ECO must draw up a strategy and budget to mitigate the impact of the underground mining on the significant fossils.	Planning	Priority action after completion of previous action. This item will only be required if the write-up of the site visit indicates that significant fossils may be impacted upon by the proposed underground mining at Zandvoort.	Appointed Palaeontologist ECO Mine Management	ECO Applicant	To outline a strategy and budget agreed to by the palaeontologist, ECO and mine management within which the impact of the underground mining activities at Zandvoort on significant fossils will be mitigated.	(ECO Monthly Checklist/Report)

Table 6- Mitigation Measures required for Impacts on Identified Heritage Sites

No.	Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
1. Immediate Mitigation in terms of Identified Heritage Sites							
A	The Applicant together with the ECO shall identify a suitably qualified archaeologist to assist in conducting the mitigation. Once identified this individual or company must be appointed.	Planning	Immediate action that needs to be undertaken well in advance of construction	Applicant ECO	ECO (Monthly)	The appointed archaeologist would direct the way in which the potential impact can be mitigated.	(ECO Monthly Checklist/Report)
B	The archaeologist must define a suitable number of fixed points around each	Planning	Priority action after	Archaeologist	ECO (Monthly)	To obtain a base line photographic	(ECO Monthly Checklist/Report)

	identified heritage site and photographically record each site using pre-defined fixed points. This recording must be conducted in conjunction with the ECO. The archaeologist must familiarise the ECO with the principles and aims of the monitoring process and the use of fixed-point photography.		completion of previous action and needs to be undertaken well in advance of construction	ECO		record of each identified heritage site before construction commences and to provide the necessary training and exposure to the principles and techniques of the monitoring process to the ECO.	
				2. Monitoring			
A	The appointed archaeologist must be notified in writing of the commencement of the Construction and/or Operation Phases of the Mining Development	Construction and Mining Phases	Four weeks ahead of planned action.	ECO	ECO Applicant	To ensure that the appointed archaeologist is informed of the commencement of underground mining activities.	(ECO Monthly Checklist/Report)
B	The ECO must undertake monitoring visits to each of the seven identified heritage sites.	Construction and Mining Phases	Once every three months for Site 3 and Site 4 and once every six months for remainder of the sites.	ECO	ECO Archaeologist Applicant	To identify any evidence for disturbance as a result of underground mining activities.	(ECO Monthly Checklist/Report) ECO Monitoring Report
C	The ECO must compile a monitoring report subsequent to each monitoring visit providing the findings of each monitoring visit. This report must be sent to the EAP, mine manager and archaeologist.	Construction and Mining Phases	Within one week after completion of monitoring visit.	ECO	ECO Archaeologist Applicant	To provide written feedback on the monitoring.	(ECO Monthly Checklist/Report) ECO Monitoring Report

D	After receiving the monitoring report the archaeologist must purview the report and assess whether he/she is satisfied with its contents and conclusions.	Construction and Mining Phases	The archaeologist must provide his/her feedback to the ECO within one week after receiving the report from the ECO.	Archaeologist	Archaeologist ECO Applicant	To provide archaeological input in the monitoring process.	(ECO Monthly Checklist/Report) ECO Monitoring Report Written Feedback by Archaeologist
3. Measures Required should Suspected Evidence for Surface Impacts as a Result of Underground Mining Activities be Identified during Monitoring							
A	Should suspected evidence for surface impacts as a result of underground mining activities be identified during the monitoring visit, the ECO must inform the archaeologist and Mine SHEQ Manager immediately.	Construction and Mining Phases	Immediately after discovery of suspected evidence of surface impacts as a result of underground mining activities.	ECO Archaeologist	ECO Archaeologist Applicant	To ensure that the archaeologist and Mine SHEQ Manager immediately becomes aware of the suspected evidence for impacts on the identified heritage sites.	(ECO Monthly Checklist/Report) ECO Monitoring Report
B	The archaeologist will provide the ECO and Mine SHEQ with the mitigation measures that will be required from this point onward. The exact mitigation measures to be followed would depend on the characteristics of the discovery and conditions of the site.	Construction and Mining Phases	48 hours after written receipt of photographic evidence or report from ECO.	Archaeologist	Archaeologist ECO Applicant	To outline the exact mitigation measures required.	(ECO Monthly Checklist/Report) ECO Monitoring Report

Table 7- Action Plan for Implementation

ACTION PLAN				
Phase	**Management Action**	**Timeframe for Implementation**	**Responsible Party for Implementation (Frequency)**	**Responsible Party for Monitoring/Audit/Review (Frequency)**
Planning	Identify and appoint suitably qualified palaeontologist.	Immediate action	Applicant ECO	ECO (Monthly)
Planning	Identify and appoint suitably qualified archaeologist.	Immediate action	Applicant ECO	ECO (Monthly)
Planning	The archaeologist must define a suitable number of fixed points around each identified heritage site and photographically record each site using pre-defined fixed points. This recording must be conducted in conjunction with the ECO. The archaeologist must familiarise the ECO with the principles and aims of the monitoring process and the use of fixed-point photography.	Priority action after appointment of archaeologist.	Archaeologist ECO	ECO (Monthly)
Planning	A single site visit must be undertaken by the appointed palaeontologist to the existing mining operation located adjacent to Zandvoort.	Four weeks after appointment of palaeontologist and well ahead of commencement of construction phase.	Palaeontologist	ECO (Monthly)
Planning	The appointed palaeontologist must produce a write-up of his/her findings in terms of the site visit. This write-up must be presented to the ECO, Mine Manager and SAHRA.	Two weeks after completion of site visit.	Palaeontologist	ECO (Monthly)

Planning	Should the write-up show that significant fossils may be impacted upon by the proposed underground mining activities at Zandvoort, the palaeontologist in conjunction with the ECO and Mine Management must outline and agree to a strategy and budget within which the impact of the proposed mining activities on palaeontology will be mitigated.	At least two weeks before commencement of construction.	Palaeontologist	ECO (Monthly)
Construction and Mining	The appointed archaeologist must be notified in writing of the commencement of the Construction and/or Operation Phases of the Mining Development	At least four weeks in advance of planned commencement of Construction and Operational Phases.	ECO	ECO (Monthly)
Construction and Mining	The ECO must undertake archaeological monitoring visits to each of the seven identified heritage sites. This monitoring will comprise a fieldwork team consisting of one archaeologist.	On the pre-scheduled day(s) with a frequency of once every three months for Site 3 and Site 4 and once every six months for the remaining sites.	ECO	ECO Monitoring Report ECO (Monthly)
Construction and Mining	The ECO must compile a monitoring report subsequent to each monitoring visit providing the findings of each monitoring visit. Each monitoring report must be sent to the EAP, mine manager and archaeologist.	One week after each monitoring visit.	ECO	ECO Monitoring Report ECO (Monthly)
Construction and Mining	After receiving the monitoring report the archaeologist must purview the report and assess whether he/she is satisfied with its contents and conclusions.	One week after receiving the monitoring report from the ECO.	Archaeologist	Written Feedback by Archaeologist ECO Monitoring Report ECO (Monthly)

13. CONCLUSIONS AND RECOMMENDATIONS

PGS Heritage was appointed by Environmental Impact Management Services (Ltd) (EIMS) to undertake a Heritage Impact Assessment for proposed underground mining on the farm Zandvoort 10 IT for the existing Pembani Coal Mine. This farm is located 3.5 km north east of Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

The purpose of the Heritage Impact Assessment report is to assess the impacts of a proposed development on the identified heritage resources. This is important because heritage resources are protected in terms of the National Heritage Resources Act, No 25 of 1999, (NHRA) from *inter alia*, destruction or damage, excavation or removal, or other disturbance, without a permit from the responsible heritage resources authority. The National Heritage Resources Act, No 25 of 1999, (NHRA) states that heritage resources are unique and non-renewable and, as such, any impact on such resources must be seen as significant (NHRA, section 5(1)(a)). The NHRA specifically protects certain categories of heritage resources, i.e.: structures, archaeological and paleontological (including meteorological) sites and material and graves and burial grounds (NHRA, sections 34, 35 and 36). Furthermore, Section 38 of the NHRA provides for and regulates the compilation of impact assessment reports of heritage resources that may be affected by construction or development activities.

The desktop research undertaken for this report has revealed that the study area and surrounding landscape have an archaeological and historical history which spans a very long time. This suggested that the study area has the potential of containing archaeological and historic sites related to this timeline. Archival research conducted during the desktop study also revealed historical information relating to the early farm ownership history of Zandvoort and indicated that the farm had amongst others been owned by historical figures such as Alois Hugo Nellmapius and Hermann Ludwig Eckstein. At this point it must be noted however that although at specific periods of time these two historical figures owned portions of the farm, Zandvoort was never their home but rather formed part of a large number of farms and properties owned at any given time by these individuals as part of their respective business pursuits. An assessment of archival and historic maps was also undertaken to provide a historic layering of the study.

A team comprising two archaeologists conducted fieldwork of the study area. As no surface impacts are envisaged, the fieldwork focussed on assessing those sections of the study area with the highest potential of containing archaeological and heritage sites. This being said, the fieldwork team visited all areas of the study area. A total of seven heritage sites were identified during the fieldwork, four of which form part of a single farmstead, namely a farm dwelling, rondavel, garage and shed. The farm dwelling (and potentially associated shed and rondavel) was built in c.

1911 and as a result is older than 100 years. The three other sites identified on the property include one historic cemetery, one possible informal grave and an old farm dipping structure.
The only identified impacts on heritage resources as a result of the proposed underground mining for coal at Zandvoort 10 IT, would be on palaeontology as well as the potential (though highly unlikely) surface impact on the seven identified heritage sites. Such highly unlikely surface impacts may be surface subsidence or vibration.

Palaeontology

A palaeontological desktop study was commissioned from Dr. Gideon Groenewald and represents the final component of the desktop study. His report indicates that the study area is mainly underlain by Permian aged rocks of the Dwyka Group and Vryheid Formation, Ecca Group, Karoo Supergroup and Jurassic aged dolerite sills. The very high fossiliferous potential of the Vryheid Formation, Ecca Group strata, warranted an allocation of a Very High palaeontological sensitivity in the report to the areas underlain by the rocks of the Vryheid Formation. The Dwyka Formation was allocated a Low Sensitivity and Dolerite areas were allocated Very Low Palaeontological sensitivity. The report also stated that if underground mining is planned, all the areas of mining will have to be allocated a Very High Palaeontological Sensitivity as mining of coal is, by definition, the mining of plant fossils.

The following mitigation measures are required:

- A palaeontologist must conduct a single one-day site visit to the present mining operation on the property located adjacent to Zandvoort as soon as possible to inspect the presence of possible fossil material in the spoil heaps of the existing mine. This site visit would be aimed at assessing the potential for significant fossils to be impacted upon by the proposed underground mining activities on the Zandvoort property.
- Two possible outcomes may result from the site visit, namely: (a) the palaeontologist finds that there is no potential for significant fossil material to be impacted upon by the proposed underground mining activities. Subsequently, the palaeontologist will provide a write up of his/her findings indicating that no further work would be required. This write-up will be submitted to SAHRA. (b) The palaeontologist establishes that the potential for significant fossil material to be impacted upon by the proposed mining property does exist. The palaeontologist must then provide a write up of his/her findings and submit this to SAHRA. The appointed palaeontologist, in consultation with the mining company, must then develop a long-term strategy and budget for the recovery of significant fossils during the mining operation. This strategy may include site visits to monitor the spoil heaps, the collection of representative samples as well as the curation of fossil material.

In Chapter 8 the impact on palaeontology is identified as an environmental sensitivity, whereas Chapter 9 identifies it as an environmental constraint. The impact of the proposed development on palaeontology in terms of two different

alternatives is assessed in Chapter 10 and mitigation measures and an action plan to mitigate the impact on palaeontology is outlined in Chapters 11 and 12 respectively.

Identified Heritage Sites

All seven identified heritage sites are surface occurrences and as a result the proposed underground mining activities at Zandvoort 10 IT are not expected to have any direct negative impact on any of these seven heritage sites. Such surface impacts are unlikely if mining is undertaken correctly and safely because of the safety factors required. However potential impacts include vibration and surface subsidence, although these are highly unlikely to occur.

In the instance that such highly unlikely surface impacts do occur, the identified heritage sites which would potentially be at highest risk would be the white cemetery (with its large upright headstones) (see Site 2) and the farm dwelling (Site 4).

In Chapter 8 the impact on the identified heritage sites is identified as an environmental sensitivity, whereas Chapter 9 identifies it as an environmental constraint. The impact of the proposed development on the identified heritage sites is assessed in Chapter 10 and mitigation measures and an action plan to mitigate the potential (though highly unlikely) impact on such identified heritage sites is outlined in Chapters 11 and 12 respectively.

Conclusions

This heritage impact assessment has identified a total of seven heritage sites located within the study area, whereas the palaeontological desktop study has allocated a Very High palaeontological significance to all underground mining areas. All these identified heritage aspects were identified as environmental sensitivities as well as environmental constraints. The impact of the proposed development on these sensitivities and constraints in terms of two different alternatives were assessed. Suitable mitigation measures as well as an action plan were outlined to suitably mitigate the impact of the proposed development on these heritage sensitivities.

It is the opinion of the author of this report that if the mitigation measures outlined in this report are implemented as indicated, the proposed development can be allowed to proceed.

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Historic Topographic Maps

All the historic topographic maps used in this report were obtained from the Directorate: National Geo-spatial Information of the Department of Rural Development and Land Reform in Cape Town.

Google Earth

All the aerial depictions used in this report are from Google Earth.

Internet References

www.sahistory.org.za
www.wikipedia.org

ANNEXURE A

HERITAGE ASSESSMENT METHODOLOGY

The significance of heritage sites is based on four main criteria:

- **site integrity** (i.e. primary vs. secondary context),
- **amount of deposit, range of features** (e.g., stonewalling, stone tools and enclosures),
  - Density of scatter (dispersed scatter)
    - Low - <10/50m^2
    - Medium - 10-50/50m^2
    - High - >50/50m^2
- **uniqueness** and
- **potential** to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, will be used for the purpose of this report.

Table 8: Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction

Generally Protected C (GP.C)	Grade 4C	Low Significance	Destruction

ANNEXURE B

THE SIGNIFICANCE RATING SCALES USED IN THIS REPORT

Method of Assessing Impacts:

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E+D+M+R)}{4} \times N$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 9:

Table 9: Criteria for determination of impact consequence.

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),

	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

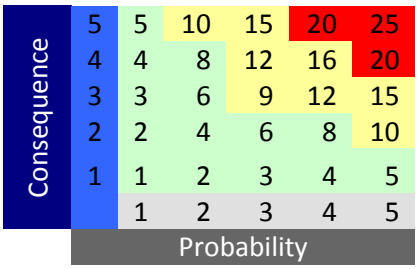
Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 10.

Table 10: Probability scoring.

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P



The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 11.

Table 11: Significance classes.

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/ mitigated.

Impact Prioritisation

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in Section 0 it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority / significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/ mitigation impacts are implemented.

Table 12: Criteria for the determination of prioritisation.

Public response (PR)	Low (1)	Not raised as a concern by the I&AP's
	Medium (2)	Issue/ impact raised by the I&AP's
	High (3)	Significant and meaningful response from the I&AP's
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 12. The impact priority is therefore determined as follows:

Priority = PR + CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (refer to Table 13).

Table 13: Determination of prioritisation factor.

Priority	Ranking	Prioritisation Factor
= 3	Low	1
3 > 9	Medium	1.5
= 9	High	2

In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Environmental Significance Rating	
Value	**Description**
< 9	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥9; <17	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 17	High (i.e. where the impact must have an influence on the decision process to develop in the area).

ANNEXURE C

PALAEONTOLOGICAL DESKTOP STUDY